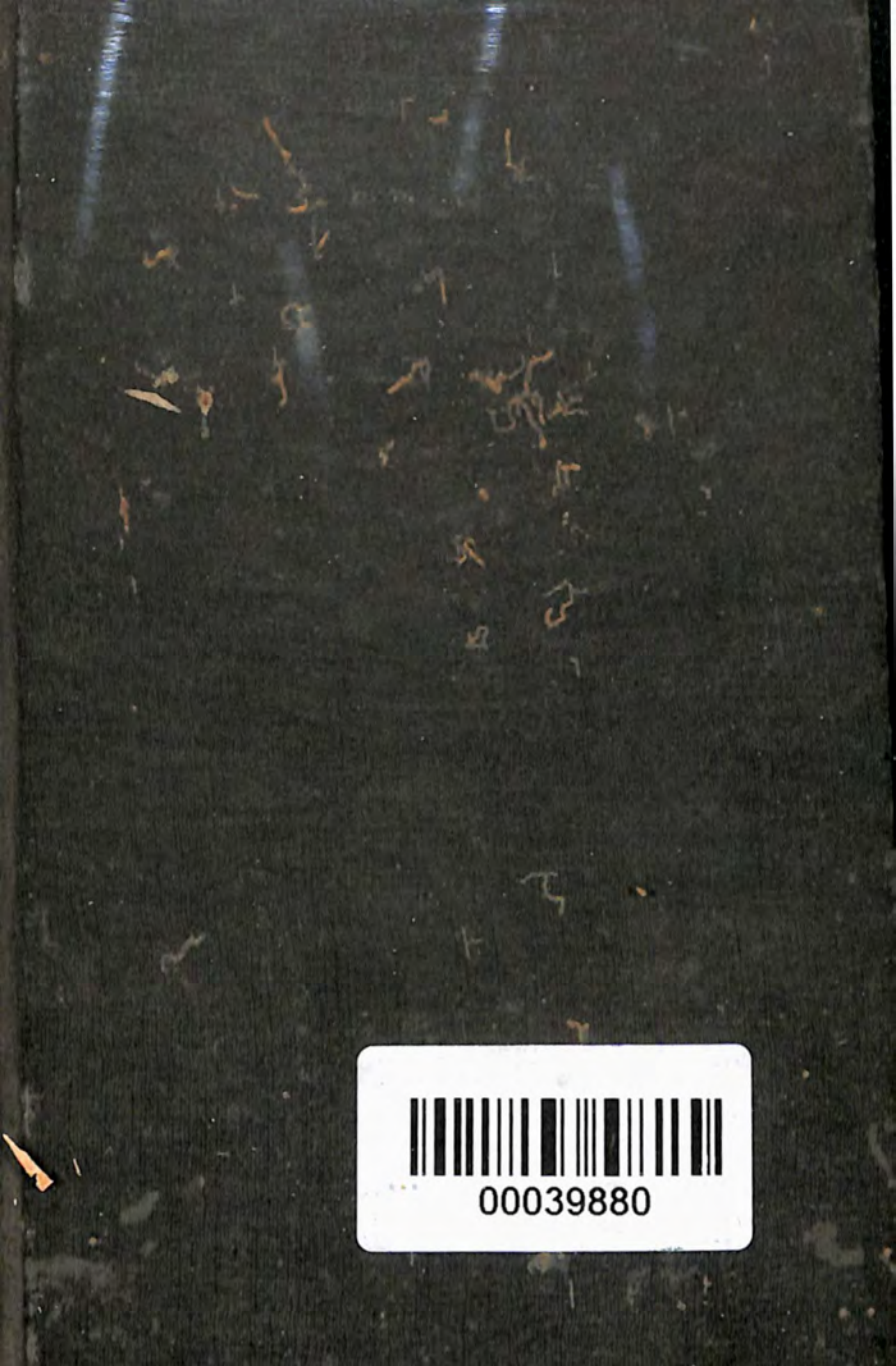
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Zoology
by
William B.
Carpenter. vol I

39880

AUTHOR'S PREFACE.

In the preparation of this Treatise, the Author has kept steadily in view the objects at which he has aimed in the preceding volumes, and in the attainment of which he trusts that he has been in some degree successful;—namely, the Exposition of the *principles* of Science in their simplest form, and the Illustration of these by the most useful and interesting examples. He has so fully explained his views on the utility of the study of Zoology, and on the mode in which it may be most advantageously pursued, in the Introduction and First Chapter of the present volume, that he considers any further remarks on these subjects here uncalled for.

The *general account* of the Classes is translated, with some additions and modifications, from the "Cours Elémentaire de Zoologie" of M. Milne-Edwards; a work adopted by the French Government as the Text-Book of instruction, in the Colleges connected with the University of Paris; and the whole of the beautiful illustrations prepared for that Treatise will be found in the present volumes. For the more detailed accounts of the Orders, Families, &c.,—as well as for the first Two Chapters, the Author is solely responsible. In the preparation of these portions of the work he has availed himself of the best and most recent sources of information; and has endeavoured to adopt the most approved systems of Classification. As scarcely any two Naturalists agree, however, on this head, the choice has been frequently a matter of difficulty; and he cannot suppose that he has been always equally successful. He has adopted as his chief guides, the last Edition of the Synopsis of the British Museum; and the Pictorial Museum of Natural History, at present in course of publication; and to the latter of these works he is also under great obligation, for numerous details, obtained from sources to which he might not otherwise have gained access.

A little reflection will show, that *any* general Zoological Treatise must necessarily be in great part a Compilation from the works of other Naturalists; and the merit of an Elementary work like the present, must consist rather in the judgment shown in the selection and arrangement of the materials, than in the originality of its contents. How far the Author has succeeded in his present attempt, it will be for his readers to decide.

W. B. C.

PREFACE TO THE PRESENT EDITION.

An interval of twelve years having elapsed since the appearance of the first edition of "Carpenter's Zoology," it was found necessary, upon its republication, to submit the whole work to a careful revision, in order to render it an accurate representation of the present state of Zoological Science. Dr. Carpenter, who would of course be the fittest person to revise his own book, was prevented by his numerous avocations, coupled with the state of his health, from entering upon an undertaking which would necessarily require a considerable amount of time and labour for its due performance; and under these circumstances the Publisher, with Dr. Carpenter's concurrence, applied to the present Editor to undertake the task. This he has performed to the best of his ability, although, from his being placed in the somewhat anomalous position of the Editor of the work of a living Author, it was not without its difficulties.

In preparing this edition, the Editor has endeavoured to preserve as much as possible of the original work, and also to maintain and follow out the Author's mode of treatment in those parts which required alteration. Changes have been introduced only when they appeared to be imperatively called for; and in some instances, where a difference of opinion still exists in the minds of Zoologists, the original statements of the Author have been retained, even where opposed to the Editor's own views. In the first volume, which treats of the higher Vertebrated Animals, the alterations are comparatively few, and relate principally to matters of detail; the most important being the elevation of the Batrachia to the rank of a distinct class. The second volume, however, containing the Fishes and the Invertebrated Animals, required to be in great part remodelled, in order to give due systematic effect to the numerous and important discoveries which have been made of late years in the anatomy and history of the lower classes of the animal kingdom.

W. S. D.

London, 9th September, 1857.

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INTRODUCTION.

OBJECTS AND NATURE OF ZOOLOGICAL SCIENCE; PLEASURES AND ADVANTAGES OF THE STUDY.

The *objects* of Natural History are perhaps in general less clearly understood than those of most other sciences, even among those who pursue it as their professed employment. And it is partly in consequence of this misconception, that its *advantages* as a means of intellectual and moral cultivation, and the *pleasures* which arise from the pursuit have been, in the opinion of the Author, very commonly underrated. It is usually supposed to be a Science of *names* and of *intricate classification;* but it will be shown, in the course of this Introduction, that these are *not* the objects of the Science, but merely furnish the mechanism (so to speak), by which its true ends are to be attained.

In Natural History, as in all departments of Philosophy, the first step is made by collecting and registering *facts*,—just as the Astronomer collects *his* facts, from observation of the movements of the heavenly bodies,—or the Chemist, from experiments upon the properties of the different substances found on the earth. In these last sciences, it is as requisite, as in Natural History, to give *names* to the objects whose movements or properties are being described; simply in order that various Astronomers or Chemists may be enabled to *compare* their observations, which they could not readily do, if there were no name or title to designate them. This may be easily understood, from such a case as the following. Let the reader suppose himself to be often

in company, in public meetings, and private society, with a gentleman of whose *name* he was ignorant, but who might take so active a part in the proceedings or conversation, as strongly to attract his attention. He would himself have no difficulty in recognising this individual, on one occasion after another; and he might form an opinion of his character, from the actions he witnessed, or the opinions he heard expressed by him. Now a knowledge of his *name* would add nothing to his information respecting such an individual; unless an acquaintance with his name led to some further knowledge—as of his family, or of his proceedings elsewhere,—which might throw additional light on his character. But suppose the reader to wish to make the character of this individual a subject of discussion with a friend, who might have had the same or other opportunities of observing it; he could not do so, without making his friend know to what individual, among the many into whose society they might have been thrown together, he was referring. Now he might make this known to him by describing his countenance, person, dress, manner, voice, &c.; but to do this with sufficient certainty would often require some time and trouble, all of which might be saved by a knowledge of the *name* by which he is at once distinguished.

Now the real use of *names* in Natural History may be easily understood, from the similar case just given. Every living being, whether plant or animal, furnishes the Naturalist with a group or collection of facts, to be examined and compared. He has first to observe the form and arrangement of the external parts of each; then its internal structure, which ought to be very minutely investigated; then its physiological actions, or the changes which it undergoes in the progress of growth and decline; then the habits connected with these; and lastly, the alterations which these may undergo, from a difference in mode of life, or from diseased actions. Now when it is considered that in order to make even the *foundations* of the science complete, all this knowledge ought to be gained respecting each of the many

hundred thousand species of Plants and Animals existing on our globe, it is evident that this labour must be greatly subdivided, that it may be undertaken with any chance of success. Each Naturalist chooses a department most conformable to his own taste, or to his opportunities for pursuing it; one confining himself, for example, to the study of the external forms of some particular group; another to the examination of its internal structure; a third devotes himself to physiological inquiries; and a fourth to the observation of the habits and instincts of the respective beings, in a state of nature. Now it would be quite possible to pursue any of these inquiries without a knowledge of the names, which had been imposed upon the objects that fall under our observation; and the pleasure derived from such pursuits is but little impaired by this ignorance. What does it matter, for example, to the Microscopic observer, whether he is or is not acquainted with the name given to some Animalcule, whose movements he might be watching with the greatest interest, by some former observer, who very probably knew much less of its structure and actions than himself? But if we wish to unite or compare our observations with those of others, a knowledge of names becomes highly desirable, in order to save the time, trouble, and uncertainty which will otherwise be involved. The Author may mention an example of this kind, which occurred some time since in his own experience. He observed a very active movement of the reproductive granules, or "zoospores," of a species of Sea-weed, in which, to the best of his belief, it had not been previously seen. Now, in order to place this observation upon record, it *might* certainly answer to give such a general description of the plant as would probably serve to point it out to other observers; but such a description, not drawn up by a Botanist who had paid especial attention to the study of the Algæ, would be very probably erroneous or defective, and might consequently leave it uncertain which species of Sea-weed was really meant. But by ascertaining the name of this

specimen to be *Ulva Linza*, he becomes able to publish his observation, in a form which at once enables any other observer to seek for the plant, and to repeat or extend his inquiry.

This is, however, the only utility of *names* in Natural History, or in any other science. They serve, like money, as the medium of exchange. And for those who pursue science for their amusement only, it cannot be desirable to burden the memory with a large number of names, which can only now and then be useful, and which can easily be ascertained when wanted. —Juliet's question—"What's in a name?"—has a more extensive applicability than she probably dreamt of at the moment she uttered it; yet her own reply shows her to have had a clear notion in her mind, that, in other objects, as well as in her lover, *names* and *properties* have no essential connexion;—"that which we call a rose, by any other name would smell as sweet."

Let us now examine, in a somewhat similar manner, the value of Classification, in the scientific pursuit of Natural History. A very cursory inspection of the forms and structures of the different tribes of living beings, which are constantly presenting themselves to our notice, may satisfy the observer, that amongst all there are *resemblances* and *differences;*—between some, the *similarity* being a prevailing feature, whilst between others the *differences* are most obvious. Amidst all their variety, he perceives on closer examination such a prevailing uniformity, that he is led to believe that they are all formed on some general *plan* or *system*, analogous to that which is seen to prevail in other portions of the Creator's works. And just as the Astronomer is enabled to show, that the great principle of mutual attraction between all the masses of matter in the Universe, not only governs the regular movements of the heavenly bodies, but is constantly producing slight modifications or perturbations in their course (see ASTRONOMY),—so does the Naturalist hope that, in the living Kingdoms of Nature, some principle may be dis-

coverable, which not only governs the uniformity that exists in the structure and actions of all the creatures belonging to them, but produces those numerous deviations from it, which are at first sight so perplexing.

To discover this plan, therefore, is the highest object of the scientific Naturalist; and all his endeavours should be directed towards it. There is no fact or class of facts relating to the structure, actions, or habits of living beings, which can be useless to him. That which seems, when regarded alone, to be of trivial importance, is often found, when united with others, or placed in a different light, to possess an unexpected value. Every one, therefore, who carefully observes any occurrences that may fall beneath his notice, and scrupulously records, not his inferences from them, but the facts themselves, may be regarded as contributing towards the advancement of the science. And when we consider how little is known, compared with that which remains to be discovered, it is obvious that there are few who cannot do *something*. The man of active and observant mind, whatever be his regular object of pursuit, may find many opportunities of rendering important services to Science, by simply watching that which passes before him, and committing to writing what he notices. A fund of interesting and valuable anecdotes regarding our native animals, may thus be collected by an attentive observer, who is nevertheless ignorant of their scientific names, their internal structure, or their place in a classification: and these may be of the greatest service in completing the histories which have been already ascertained, in regard to their structure and physiological actions; and in explaining the uses of parts, which were previously unknown.

But the inability to go abroad and observe Nature in the field, need be no obstacle to those, who are inclined to pursue a course of investigation into her phenomena; for such persons may advantageously employ themselves in inquiring into the minute structure, and vital actions, of even our commonest Plants and

Animals, which are very far from having been completely studied; and to these the Microscope will be found a never-ending source of amusement and instruction. The most curious facts we possess in regard to the influence of light on the development of the Vegetable structure, were ascertained by the observation of one of its commonest and simplest forms, the humble *Liverwort;* and the progress of discovery is almost daily revealing to us something new in the structure of animals with which we imagine ourselves to be well acquainted. A very limited knowledge of names and classification is required for the successful pursuit of such inquiries; although there is doubtless a great advantage in a previous acquaintance with the *general principles* of Natural History, both in preserving the inquirer from erroneous conclusions, in directing him to new subjects for observation, and in heightening the pleasure which he derives from his pursuit. But such a view need not involve details which are burdensome to the memory; nor diminish the feeling of *freshness*, which we derive so much more strongly from surveying the wonders of Nature for ourselves, than from becoming acquainted with them through the writings of others.

Thus, although no one can go far in the *scientific* pursuit of Natural History, without some knowledge of names and of classification, yet this is but little required by those who pursue certain departments of it for their own pleasure and improvement. For it cannot be too constantly borne in mind, that in its present state (which is much less perfect and complete than that of almost any other science), there is ample room for the labours of all who devote themselves to it as their regular object of pursuit, and with the intention of raising it in the scale of the sciences,—much more, therefore, for the less constant inquiries of those, who seek but for refreshment and novelty by occasionally turning to the study of Nature, from the harassing cares of business, or the wearying monotony of a handicraft occupation, and who are content with the humbler but not less honourable task of collecting and

supplying the materials with which the skilful builder may erect his edifice. There cannot be a more beautiful example of that adaptation which exists between the faculties of the human mind and the objects of human knowledge, than the variety of modes in which the study of Natural History may be pursued, and the corresponding variety of tastes which we meet with in those who devote themselves to it. For whilst some busy themselves in simply collecting the birds, the insects, the zoophytes, or the plants which they meet with in their neighbourhood, and delight in ascertaining those characters by which their place in a classification may be determined; others avail themselves of the materials thus brought together, and (perhaps without ever themselves going abroad into the fields, or even confined, it may be, to a narrow apartment in the middle of a crowded city), delight in examining their internal structure, toilsomely unravelling the details of their organisation, and scrutinising, with the aid of the Microscope, their minutest parts;—others, again, prefer to leave the birds, the insects, the zoophytes, or the plants, unmolested in their native haunts, but devote themselves to the observation of their habits, the examination of their economy, the recording of their actions;—whilst the scientific Naturalist, whose talent lies rather in generalising than in observing, and who is versed in the principles which have been already ascertained in regard to the structure, physiology, habits, and classification of the objects of his study, seeks to combine the observations of others, in such a manner as to correct what has been erroneous in his previous system, to extend it to new and previously unknown forms of animated being, and to develope those beautiful analogies and connections, which show the whole to be parts of one vast plan, the work of one Almighty and Omniscient Creator.

As the labours of all these are necessary to the building-up of the Science of Natural History, it is well that such diversity of tastes and of mental faculties should exist; since all the subjects receive their due share of attention, which could not be if there

were a greater uniformity in the constitution of the human mind. And, for the same reason, neither of the labourers should despise or undervalue the labours of his fellows; since each department has its peculiar value, and the pursuit of it cannot be rendered useless by any advance in the rest. Thus, the mere collection of specimens, and the arrangement of them according to their external characters, is, in fact, laying the foundation for the operations of the scientific Naturalist. Even in districts which have been most completely explored, it will be rare for the diligent collector to find himself unrewarded by the discovery of some species new to that locality, if not previously altogether unknown. But in those which have been as yet comparatively little examined, it cannot be doubted that a rich harvest of discovery awaits every one who will devote himself to the search for it. We need not leave our own island for this purpose. To the number of the larger animals which tenant the land we cannot expect any considerable addition; but not a year passes without many new species of insects being discovered; and there are several parts of our coasts that are rich in marine tribes, of which very little is yet known, and which, consequently, hold out the most tempting prospect to the collector. In all such researches, the *locality*, and the other circumstances in which the specimen is found should be carefully noted; for the collection then has a double value,—not only on its own account, but as affording information on a most interesting and important department of zoology—the geographical distribution of animals.

As to the importance of the study of the Anatomy and of the Habits of the animals brought together by the collector, it would seem unnecessary to say anything here. It will be shown in the course of the present Treatise, that the classification of Animals must be founded upon their *general* structure, not upon a few external characters; and that the value of these last in Zoology, is chiefly that they serve as a ready key or index to the internal organisation, when the connexion between them has been

once established (§ 55). Hence, the Comparative Anatomist may be said to prepare the cement by which the materials furnished by the Collector are to be united together. But the arrangement and combination of the whole is the work of the Philosophic Zoologist; whose department requires the exercise of all the highest faculties of the mind, and whose work cannot be perfect, unless he has obtained and mastered *all* the information which has been accumulated by the labours of his associates. Now it is possible to pursue each of these departments to a certain degree independently of the rest; and many have done so with considerable success. But, on the other hand, the success will be probably greater, in proportion to the amount of the *general* knowledge of the whole subject, which is already possessed; and the interest of the pursuit, whichever department of it may be undertaken, is also greatly enhanced.

We have dwelt upon the opportunity which the study of Natural History offers to almost every one for the promotion of its purposes as a Science, because it differs from most other branches of knowledge in these respects,—that the objects it embraces are almost illimitable in their extent,—that our information respecting almost every one of them is still very scanty,—and that there is, consequently, the most abundant opportunity for every one to benefit mankind, by assisting in the collection of materials for the extension of the Science, whilst obtaining recreation and healthful employment for his own mind. And if we consider the ultimate objects of Science, it must be acknowledged that no more worthy motive for such pursuits can be set before the mind, than that which is directly connected with it. For its purpose is the discovery of those simple laws which are the *highest truths* to which Reason (unaided by Revelation) can conduct us, in regard to the character and dealings of the Creator. Hence, in the pursuit of Science, if conducted in a right spirit, we are guided by that simple love of Truth, which is, as Sir H. Davy has beautifully observed, "in its ultimate and most

perfect development, the love of Infinite Wisdom and unbounded Power, or the love of God." But it is not every mind which is conscious of this high and noble aspiration. In many it exists without the knowledge of its possessors, and needs to be awakened from its dormant condition. In some it seems almost or altogether deficient. It cannot be amiss, then, to hold out some of the more direct *advantages* which attend the cultivation of Natural History. These are twofold:—the first bearing upon Man's corporeal wants; the second upon his mental and moral state. A single illustration, having reference to each of these points, must here suffice.

There are many species of Insects, whose voracity (especially in the larva state) is so great that, when they are present in large numbers, they become a source of the most terrible devastation. We have examples of this kind, on a small scale, in our own country. Thus the grubs of some of the Beetles, and especially of the Cockchafer, would speedily destroy the roots of all our corn and grasses, were they not themselves eagerly sought after as food by the Rook and other birds. It is true that, when the supply of these is exhausted, the Rook will support itself upon new-sown wheat. But the injury which it thus does to the farmer is as nothing compared with that from which it saves him; and if this tribe of birds were to be extirpated, a famine would speedily follow. In many parts of this country, however, popular ignorance has prevailed so far as to cause the destruction of rookeries, under the idea that the birds devour a large quantity of grain; but so speedy has been the multiplication of the real enemies of the agriculturist, when no longer kept within limits, that the restoration of the birds has been, in every instance, petitioned for within a few years. The larvæ of the Turnip Fly committed the most serious ravages in some of the eastern counties of England, a few years since; and no method was found so effectual as the turning a large number of Ducks into the turnip-fields; for these birds, being the natural enemies

of the grubs, stripped the plants of them much more rapidly than human hands could have done, and were, besides, themselves rendered very fat and fit for the table.—But the destruction of vegetation which occasionally results from such causes in this country, is as nothing to that which frequently takes place in warmer climates. No insect is so largely concerned in this as the Locust, of which immense swarms occasionally make their appearance, traversing a great extent of country, and clearing it so completely of its vegetation, as to leave scarcely a trace behind, save the leafless skeletons of the trees and shrubs, whose softer parts they have destroyed. Numerous attempts have been made to keep down the multiplication of these insects by rewards offered for the destruction of their eggs and larvæ; but none of these have been effectual. The sagacious Naturalist, however, who duly considers the relations between different tribes of organised beings, who bears in mind that there is not one species of plant or animal which is not the destined food of another, and who calls to his aid the power which the Creator has given to Man over the animated world—not for its destruction, but for its protection and regulation—will not have much difficulty in devising a means far better adapted than those just mentioned, for the object in view. He will ascertain what species is most opposed to the one he is desirous of eradicating; and, by encouraging its multiplication, he will put a far more complete check upon the ravages of his enemy, than by any scheme that may appear more direct in its operation. There is a bird in India, termed the Grakle, which performs the same office in regard to the eggs and larvæ of the Locusts, that the Rook and similar birds fulfil in colder countries. Nevertheless, the inhabitants, being ignorant of the benefits they derive from it, have sometimes sought to exterminate it; and when they have done this, the same consequences result as when a Rookery has been destroyed in this country;—viz., a great multiplication of the destructive insects formerly kept in check. The following history affords a curious example of this occurrence:

We are informed by Buffon that there was once a danger of the island of Bourbon being entirely devastated by locusts; the eggs of which were introduced with some plants from Madagascar. They were rapidly multiplying, and the produce of the fields was in progress of being destroyed. But the Governor, who was a man of superior intelligence, learning the great services which the Grakle performed in India, had a number of pairs introduced and distributed over the islands. They bred very fast, were diligent in their labours; and in a few years the locusts seemed extirpated. When this took place, the Grakles began to dig and examine the newly-sown fields; and the colonists, concluding that they did so for the purpose of eating the seeds, (when they were in reality only searching for the eggs of the locusts), took the alarm, got them proscribed by government, and speedily exterminated them. In a few years, however, they perceived their error; for the ravages of the locusts recommenced. Upon this the governor procured a second supply of birds from India; and the state took charge of their preservation. Special laws were framed for their protection; and, lest the people should have a hankering for grakle pie, the physicians were instructed to proclaim their flesh very unwholesome food. But this *extraordinary* care was injurious. The birds soon again cleared the island of the locusts, and destroyed the grubs which injure the coffee plantations. But when this supply failed them, they proceeded to attack the corn-fields and orchards; and even killed the young of pigeons, and other domestic birds. In order to restore the balance, a sort of Malthusian law was enacted, to prevent their numbers from exceeding the quantity of their legitimate food; and, when thus kept in check, they continued to do good without any admixture of evil.

Many similar examples might be adduced, to illustrate the advantages which a very moderate acquaintance with Natural History confers upon its possessor, and the injurious results which proceed from ignorance of its simplest principles. But it is a very partial view of the objects of Science, which looks for

its benefits in the improvement of the corporeal, temporal, and earthly condition of Man,—which regards as its *direct* advantages the contributions it makes towards his comfort, his luxury, his refinement,—and which considers as a mere *collateral* result, or as an accident by the way, its influence on his spiritual, immortal, celestial being. Surely it is *here* that we are to look for its most permanent, most direct, most important advantages. The works of the Creator, when they afford neither sustenance nor physic for the body, yield both food and medicine for the mind. It is surely a more worthy occupation, to study the works of Infinite Wisdom and boundless Power, than to bestow the labour of a life upon the critical examination of a Greek Drama or a Latin Satire. And it is surely a more likely means of advantageously developing the intellectual and moral faculties of the young, to exercise them upon the objects which are everywhere around them, and a knowledge of which will be useful to them in almost every possible scene of their future lives, than to confine them to subjects which leave many of their powers unemployed, and numerous sources of the purest pleasure undeveloped. "Strange indeed," it has been well remarked, "must be the perversion of that mind, which is made neither wiser nor better, by studying the works of Him, whose own wisdom is infinite, and all whose operations tend to good and happiness."

The *observing* powers are especially cultivated by the study of Natural History. The organs of the senses are the portals, through which all our knowledge of the world around us makes its entry into our minds. In the infant and the young child, they are set wide open; and we see how rapid is the development of the faculties by the information they communicate. Yet, in ordinary systems of education, this process is almost entirely checked, during the period when it might be continued with the greatest advantage; and the learning of the schools is substituted for the teachings of the great Book of Nature. It is not enough that the senses should be used;—they must be *used aright*.

To *observe well* is not so easy a thing as some persons imagine. Some are too hasty, imagining that they can take in everything at a glance, and often forming very erroneous or imperfect notions. Others are too slow, fixing their attention too exclusively on the details, so as to lose sight of the general plan. Both these faults should be carefully avoided; and the habit of guarding against them, once acquired, will be of invaluable service in future life. There is also a danger in allowing our observations to be influenced by previously formed ideas; so that we often think we see what exists only in our own imaginations. This habit cannot be too early checked; and there is probably no better mode of preventing its formation, than the accustoming the young to exercise their organs of sense upon the numberless objects which the study of Nature brings under their notice, and to give careful and accurate descriptions of what they observe. It has been sometimes said that there are more false facts, than false theories, in science; and if this is true of any department, it is of Natural History. It is wonderful how the most acute and profound reasoners have erred, when they have trusted too much to their own observations, and too little to the statements of others, who may have been much more competent than themselves as observers, though far inferior as reasoners. This was not unfrequently the case with the great Bacon; who, so far from contributing anything to our knowledge of facts in Natural History, often gave additional force to errors by the weight of his authority. Many examples of this will be found in his treatise entitled "Sylva Sylvarum;" the following will here suffice.

The Misseltoe is included by Bacon among the excrescences, which sometimes grow from trees as a consequence of disease. "They have an *idle tradition*," he says, "that there is a bird called a missel-bird, that feedeth upon a seed, which many times she cannot digest, and so expelleth it whole; which, falling upon the bough of a tree that hath some rift, putteth forth the Missel-

toe. But *this is a fable;* for it is not probable that birds should feed upon what they cannot digest. But allow that, yet it cannot be, for other reasons; for, first, it is found but upon certain trees, and those trees bear no such fruit as may allure that bird to sit and feed upon them. It may be, that bird feedeth upon the misseltoe berries, and so is often found there; which may have given occasion to the tale. But that which maketh an end of the question is, that misseltoe hath been found to put forth under the boughs, and not only above the boughs; so it cannot be anything that falleth upon the bough." He then goes on to argue that this plant, which he considers as a superior kind of fungus, is produced by "abundance of sap in the bough that putteth it forth," which, he says, may be *certainly set down;* as also that "this sap must be such as the tree doth excern and cannot assimilate, for else it would go into a bough; and, besides, it seemeth more fat and unctuous than the ordinary sap of the tree; both by the berry, which is clammy; and by that it continueth green winter and summer, which the tree doth not." The vegetable Physiologist, however, is now well assured, that the Misseltoe is a distinct and independent plant, springing, like others, from seed, and drawing its nourishment from the juices of the tree on which it has germinated (VEGET. PHYSIOL. ch. ix.); and a little careful observation of the habits of the Missel-Thrush and other birds would have shown to the great philosopher, that they really perform the office which is commonly attributed to them—that of diffusing the plant, by dropping its seeds in situations where they may fall into the chinks and hollows of trees,—but which he denied on very insufficient grounds.

There are two other tendencies which exist, more or less, in almost every mind; and which must be especially guarded against by those who desire to render the study of Nature really beneficial to their own minds, whilst promoting the improvement of science. These are, the love of the marvellous; and the inclination to rest satisfied with superficial resemblances.

An amusing illustration of the effects of these may be drawn from a large volume, entitled "Gerarde's Herbal," first published near the end of the 16th century, but looked up to by many of a generation not long since passed, as their chief botanical authority. "Having travelled," he says at the conclusion of his volume, "from the grasses growing in the bottom of the fenny waters, the woods, and mountains, even unto Lebanus itself—and also the sea and bowels of the same—we are arrived at the end of our history; thinking it not impertinent to the conclusion of the same to end with one of the marvels of this land, we may say of the world—the history whereof, to set forth according to the worthiness and variety thereof, would not only require a large and peculiar volume, but also a deeper search into the bowels of Nature than my intended purpose will suffer me to wade into, my sufficiency also considered. There are found in the north parts of Scotland, and the islands adjacent, called Orchades, certain trees whereon do grow certain shells of a white colour, tending to russet, wherein are contained little living creatures; which shells, in time of maturity, do open, and out of them grow those little living things, which, falling into the water, do become fowls, which we call Barnacles, in the north of England Brant-geese, and in Lancashire Tree-geese; and the other that do fall upon the land, perish and come to nothing. Thus much by the writings of others, and also from the mouths of people of those parts, which may very well accord with truth."

"*But what our eyes have seen and our hands have touched,*" continues the Author, doubtless with full sincerity, "*we shall declare.* There is a small island in Lancashire called the Pile of Foulders, wherein are found the broken pieces of old and bruised ships, some whereof have been cast thither by shipwreck, and also the trunks and bodies, with the branches of old and rotten trees, cast up there likewise, whereon is found a certain spume or froth, that in time breedeth unto certain shells, in shape like

those of a mussel, but sharper pointed, and of a whitish colour; wherein is contained a thing in form like a lace of silk finely woven as it were together, of a whitish colour, one end whereof is fastened unto the inside of the shell, even as the fish of oysters and mussels are; the other end is made fast unto the belly of a rude mass or lump, which in time cometh to the shape and form of a bird; when it is perfectly formed, the shell gapeth open, and the first thing that appeareth is the foresaid lace or string; next come the legs of the bird hanging out, and as it groweth greater, it openeth the shell by degrees, till at length it is all come forth, and hangeth only by the bill. In short space it cometh to full maturity, and falleth into the sea, where it gathereth feathers, and groweth to a fowl, bigger than a Mallard, and lesser than a Goose, having black legs and a bill or beak, and feathers black and white, spotted in such manner as our Magpie, called in some places a Pie Annet, which the people of Lancashire call by no other name than a Tree-Goose; which place aforesaid, and all those parts adjacent, do so much abound therewith, that one of the best may be bought for threepence. For the truth hereof, if any doubt, *may it please them to repair unto me, and I shall satisfy them by the testimony of credible witnesses.*"

It is scarcely conceivable how any one could have been so led away by the love of the marvellous, as to rest upon the most superficial resemblance, in proof of the extraordinary supposition, that from a Barnacle is produced a Bird; especially when the Author tells us that so far he is satisfied by his own observation, of "what his eyes have seen and his hands have touched." The other part of his story, setting forth that these Barnacles grow upon trees, which he learned "from the writings of others, and also from the mouths of people of those parts," is by no means so discordant with truth, as they certainly do *grow on* trees, though not produced by them. Those who have seen the Mangrove trees (BOTANY, § 598) surrounding the lagoons in the islands of the tropical ocean, their pendent branches loaded with

shell-fish of various kinds, may easily excuse a popular error of this nature; but for the Scientific Naturalist of the present day to give credence to it, would be unpardonable.

The study of Natural History, then, has an obvious tendency, not only to encourage the habit of correct and unprejudiced observation in its votaries, but to call into exercise the discriminating powers, which shall teach them to attach their due value to the statements of others. Upon the advantage of such a kind of mental cultivation, it is unnecessary here to dwell. It is useful in every situation, in every relation of life. It enables us to suspend our judgment, when we are not satisfied of the stability of the grounds upon which we are to decide; and leads us to draw the line between suspicious incredulity on the one hand, and too ready assent to improbable and unconfirmed statements on the other. In the cultivation of this habit, the study of Natural History has an obvious advantage over that of the more exact Sciences. We have not yet the same guidance afforded by general laws, as that which they possess, and which enables the physical philosopher to decide at once on the truth of statements submitted to him. Tell a man acquainted with the simple laws of Matter, that a perpetual motion had been invented, depending upon strictly mechanical principles; and he will not believe it, because he knows it to be a physical impossibility. In Natural History we are to a certain extent equally safe in forming a positive decision. The differences between the skeleton of Man, and that of an Elephant or Lizard, are now sufficiently well known, to prevent our giving credence to the marvellous accounts of such prodigies, as a Man 25 feet long; these cease to astonish us (except as regards the ignorance that propagated them), now that we are acquainted with their true explanation. Nor are we in danger of allowing ourselves to be led away by an English writer of much learning, who, so late as the middle of the 17th century, attributed the origin of fossil shells and fishes to "a plastic virtue latent in the earth." But

when we place side by side the apparently contradictory statements of credible observers at the present time (take, for instance, those of Audubon and Waterton on the powers of scent possessed by the Vulture), we are compelled to suspend our judgment, until we have examined into the possible fallacies of each, and sought for more unexceptionable testimony from other sources. Now it is the very necessity of this process, which is seldom needed in other sciences, that renders the study of Natural History peculiarly advantageous as a means of intellectual culture and discipline. "If a man," says Bacon, "begin with certainties, he shall end in doubts; but if he be content to begin with doubts, he shall end in certainties."

But Natural History employs higher faculties of the mind, than those simply connected with the observation of *facts*. There is no Science which, with so extensive a basis of observed phenomena, has its materials so little connected by *general laws*. The slow progress of this is partly due to the prevalent misconception of their nature, and of the mode in which they are to be attained. It has been already pointed out, that Classification, which is so often considered as the highest object of Natural History, is but a *means* towards the pursuit of more elevated inquiries,—a means which is employed in all Sciences, but which takes a more prominent station in Natural History, in consequence of the difficulties attending it, and the diversity of the objects which come within its scope. But even though not the highest object of Natural History, it exercises mental faculties of a superior order. The mere collection of specimens, and the arrangement of them under their respective divisions, is a useful exercise to the growing mind; teaching, as it does, the habits of patient discrimination and careful comparison. But this may be carried too far. It is not uncommon to meet with persons, in whom the *amor habendi* (love of possessing), engrosses every other feeling to which the pursuit of science ought to give rise. These are, indeed, *mere* collectors; estimating their

acquirements more by the number of species they possess, than by their knowledge of those general principles, which constitute the Science of Natural History. It is quite possible for one of these pseudo-naturalists to attain a correct acquaintance with the external characters of every individual composing an extensive group; and even to contribute towards improving their classification. But he would not thereby have more claim to the character of a man of Science, nor would he have more exercised the higher faculties of his mind, than one who should learn the forms, colours, and specific gravities of all the substances with which Chemistry brings us acquainted, without making himself acquainted with the laws of chemical combination.

It is in the search after those general principles, which regulate the structure and actions of the animated as well as the inanimate creation, that the noblest powers of the human intellect are exercised; and exercised, too, in their most legitimate sphere. "Wherefore," it may be asked, "has the Creator given to Man faculties so far exalted above those of the brute creation? Wherefore has He formed him with a mind capable of seeing into the depths of space—of grasping ages in one mighty thought—of seeing with the eye of reason into things not obvious to mortal sense—of discovering and in some measure comprehending, his own sublime and ever-acting laws?" Was it merely to compensate for the partial inferiority of his bodily constitution,—was it only to give him the power of subduing the lion without his strength, of providing himself with subsistence from the antelope without his fleetness, of parrying the venomous attacks of the serpent without his cunning, of resisting the inclemency of the elements without those natural defences with which almost every other animal is provided? Surely not. We should be much nearer the truth in considering, that the Creator has provided Man with a corporeal structure inferior in many respects to that of brutes, and has left him with instinctive powers far less

developed than theirs, for the very purpose of arousing the latent energies of his mind. The greater the difficulties presented by circumstances to the supply of his wants, the more are his intellectual faculties called into exercise for their gratification. And when once excited to action, who shall set the limit to their development? The mind requires occupation, as much as the body requires food. And as we select those substances for the nutriment of the corporeal structure, which are best adapted to support its strength and to complete its growth, so should we prefer those materials for the development and invigoration of the mental powers, which are by their nature and tendency most fit to expand and elevate them. If there be no assignable limit to the powers of the human mind, it is obvious that they should be employed on objects equally extensive. Nothing can be more prejudicial to its healthy action, than to confine it to some exclusive and monotonous occupation; and nothing, on the other hand, can be more favourable to the development of its higher faculties and nobler aspirations, than to turn it, if only for the brief periods of relaxation which the necessary labours and cares of the world may leave unoccupied, to the contemplation of the works of the Great Author of the Universe. It is here alone that its powers can find their full scope; for here alone can it be felt, that however great the amount of knowledge attained, it is as nothing compared with that which is yet to be unfolded by Infinite Wisdom; and that, however great the triumphs of human skill, they are as nothing to the wonders of Almighty Power. All other departments of knowledge have their limit; and much of what is brought together by the labours of a protracted life, dies with the scholar by whose toil it has been collected. But in the study of Natural Science, no step once gained is ever lost; for it serves to plant the succeeding footsteps, by which other minds may rise into yet nearer communion with the Creator, and gain a wider survey of his works. But as all his attributes are Infinite, not even Eternity can be sufficient to unfold them to the beings He has created.

The effects which the pursuit of Natural History should produce upon the *moral* faculties, are not less valuable than those which have been adverted to in regard to the intellectual powers. And these may be recognised at the very outset of the study, if it be commenced in a right spirit. Well has the great Bacon remarked upon the "felicity wherewith God hath blessed a humility of mind, such as rather laboureth to *spell*, and so *by degree to read*, in the volumes of his creation, than to solicit and urge." "It is no less true," he elsewhere says, "in this human kingdom of knowledge, than in God's kingdom of heaven, that no man shall enter into it, 'except he become first as a little child.'" And this humility of spirit is encouraged, rather than repressed, by the subsequent progress of the inquirer; since his prospect becomes wider, every step that he takes; and his feeling of his own insignificance, in comparison with the vastness of Creation, should be continually increasing. No frame of mind can be more advantageous than this, for the reception of those other influences which the study of Nature is calculated to exert. The Naturalist who has cherished it, and who possesses also that openness to conviction which is its almost necessary result, can scarcely fail to perceive that Infinite Love is displayed in the works of the Creator, as well as boundless Wisdom and Almighty Power. In everything which he *can* trace to its causes—in which he *can* detect the mode of their operation—of which he *can* discover the design, he sees the evidence of the same attributes; and hard indeed must be the heart, and proud the spirit, and blind the understanding, that does not pass from the known to the unknown; and, *trusting* where it cannot *trace*, feel an assured conviction, that the same Almighty Power, the same boundless Wisdom, and the same Infinite Love, are as fully exercised in those instances in which they are to him least evident, as in those where they are most clearly manifested.

And thus is laid a good foundation for the reception of those truths, regarding the *peculiar* concern of the Creator in the welfare of his *human* offspring, which Revelation discloses to us. The

mind that has been led by the philosophic study of Nature (which is nothing else than the application of that reason with which man has been endowed, to the discerning contemplation of those glorious works with which he is surrounded), to recognise in it a Power which can never fail, a Wisdom which can nowise err, and a Goodness which cannot be unkind,—and which, by continually dwelling on such thoughts, has interwoven them (as it were) with itself, and made them a part of its own constitution,—is well prepared to view the Great Creator of all in that peculiarly *parental* character, in which He has been so frequently and touchingly represented to us by His inspired messengers; and to submit without a murmur to the severest inflictions of His Almighty hand, as the discipline of a Father who alone knoweth what is good for his children, and who loveth even while he chasteneth. In the events of life, as in the phenomena of Nature, he will be prepared to *trust* where he cannot *trace*; and, by the contemplation of those mercies by which every afflictive dispensation is tempered, to rise to the assured conviction,—a conviction pervading the heart, as well as satisfactory to the understanding, —that the stroke itself is not only designed by Wisdom, and given by Power, but is aimed and directed by Love. And, when this conviction *has* been attained, it finds itself reflected by every object around; and, in the contemplation of the visible works of Creation, a degree of *realisation* is given to it, which can scarcely be attained in any other way, by those who have not passed through a long course of religious experience. It should operate, too, not merely in severe trials or seasons of the deepest gloom, but in lightening the daily cares, and giving cheerfulness to the daily scenes of life; and if such be the fruits of the study, on the recommendation of which we have dwelt so long, it is indeed one not to be neglected.

CHAPTER I.

ON ZOOLOGICAL CLASSIFICATION.

1. The principles of a *Natural* arrangement of Plants or Animals having been elsewhere fully explained (Botany, Chap. I.), it will not be necessary to do more in this place than recapitulate them, with some additional illustrations of a Zoological character.

2. The object of all Classification has been shown to be,—to bring together those beings which most resemble each other, and to separate those that differ. In this manner we greatly shorten the labour which would be otherwise required from the Naturalist; since, instead of spending his time and attention in the study of *all* the characters which each specimen presents, he is at once able, by knowing its general position in the Animal scale, to see (as it were) into its interior; so that a single character often becomes the key to a great number. Thus, for instance, if we meet with an animal covered with feathers, we *know* that it must belong to the class of *Birds*; because no other animal than a Bird is endowed with this covering. And when we know it to be a Bird, we can at once attribute to it all those characters by which the members of this group are distinguished. Thus, we feel a certainty that it has a bony skeleton covered with flesh; that of this skeleton, a jointed back-bone forms the essential part; that this back-bone contains a spinal marrow, swelling at its upper end into a brain, which is inclosed within a bony casing or skull; that it is oviparous, or propagates by eggs; that it breathes air by means of lungs; that its heart has four cavities; that the blood is red, and its circulation rapid, and arranged on the same plan with that of Man; that the temperature

of the body is always high during life; that the mouth is destitute of teeth, but that its jaws are furnished with a horny bill; that the body is supported on the ground upon two legs only; and that, if its wings are sufficiently developed, the animal can raise itself into the air by their movement. All these facts, and many more, are included in the general idea of the structure of the Bird which the Zoologist possesses; but only a few of them are included in the *common* idea. For a person ignorant of Zoology thinks of little but the external characters; and attaches little else to the name of Bird, than the idea of an animal covered with feathers, possessing a pair of wings and a pair of legs, and having a horny bill. Or, if he thought of the internal structure at all, the distinction upon which his mind would naturally fix, would be the *gizzard*, or strong muscular stomach possessed by most of the birds used as food; but this would not be a proper zoological character of the class, because it is confined to a certain part of it only, and is, moreover, possessed by animals of other tribes.

3. Thus we see how much our labour is simplified, by the union into one group, of all the animals which agree in the most important or essential characters; since, by the knowledge of these characters, we are at once put in possession of a great amount of important information respecting *every one* of the animals included in the group. Thus, among the many thousand species which belong to the class of Birds, there is not a single one that does not agree in all the characters just named; and, if we should find a *new* species,—which no Naturalist had ever met with, no Anatomist had ever examined,—we might anticipate with certainty (so far, at least, as we have a right to feel certain of anything of this kind), that its internal structure would correspond with the description already given. For not only do the animals included in the class of Birds agree amongst themselves in all these characters; but they also differ from all others in having them thus combined. Thus, if we compare Birds with Insects, to which, in their mode of life and possession of the powers of flight, they bear the greatest external resemblance; we shall find the points of agreement really much fewer than the

points of difference. For the resemblance does not extend much beyond the presence of wings, the breathing of air, the reproduction by eggs, and the covering of the wings and body (in some Insects) with a kind of down. The points of difference are much more striking. For the body of an Insect has no internal skeleton, but is included within a jointed envelope, of greater or less firmness; the nervous centres, instead of being united into one continuous mass—the brain and spinal marrow, are scattered through the body in distinct ganglia; the air which enters the body, instead of being confined to certain bags or chambers, is carried through the whole, by means of a widely-distributed system of air-tubes; instead of a heart, there is a long tube, situated in the back, and divided into chambers that correspond with the segments or divisions of the body; the blood is white, and its circulation slow and feeble; the temperature of the body is usually not much above that of the air around it; the body is supported, when on the ground, upon six legs; and the eyes are *compound* in their structure, each of the dark hemispherical protuberances on the head being, in fact, an assemblage or cluster of distinct eyes. All these are characters, of which the union is peculiar to the Insect, distinguishing it from other classes; and we see how very little real conformity there can be between Insects and Birds; since the points of difference are so much greater than those of agreement.

4. The fact is, that these two classes belong to different primary subdivisions of the Animal kingdom;—the *Birds* to the group of VERTEBRATA, which is especially distinguished by the possession of an internal skeleton, protecting the nervous centres, and clothed by the muscles which communicate motion to it;—whilst the *Insects* form part of the group of ARTICULATA, in which the skeleton is external, having the muscles that move it attached to its interior, and not giving more protection to the nervous centres than it does to the rest of the body. But the class of Birds may be regarded as holding the same position in the Vertebrated series, which that of Insects does in the Articulated. They are adapted for the same mode of life; and notwithstanding the different plans on which their bodies are

constructed, there is a remarkable correspondence between several parts of their respective fabrics. Hence, they are termed *analogous* groups; and may be said to *represent* one another in the series to which they respectively belong. Thus, Birds may be termed the Insects of the Vertebrated series; and Insects may be regarded as the Birds of the Articulated.—We shall have several occasions for noticing similar analogies, in the course of this Treatise.

5. But we shall next inquire, how the characters which have been mentioned as distinguishing the class of Birds, serve to separate it from others, which have more in common with it. The classes of Reptiles and Mammals * all agree with Birds in a larger number of characters—and these, too, of the highest importance — than do Insects; notwithstanding that the difference in external form, and in habit of life, may be much greater. For they are all Vertebrated animals, possessing a jointed internal skeleton, which envelopes and protects the nervous centres, a distinct brain and spinal marrow, four members or extremities, five senses, red blood, simple eyes, &c., &c. With Mammalia and Reptiles, Birds further agree, in breathing air by means of lungs; whilst they agree with Reptiles and Fishes in being oviparous. With Mammals, again, they agree in having a heart with four cavities, and a complete double circulation (which is so arranged, as to expose all the blood to the air in the lungs, before it is again transmitted to the system); and also in constantly maintaining a high temperature. But they differ from Mammals in being oviparous instead of viviparous; that is, in depositing eggs, instead of producing their young alive and nourishing them afterwards by suckling; and in having their bodies covered with feathers, instead of with hair or scales. They differ, too, in the mode of life for which they are adapted; the Mammals (as a class) being destined to live on the ground, whilst the Birds inhabit the air: but there are exceptions in both instances, some

* This modification of the scientific term *Mammalia*, having been sanctioned by high authority, will be used in this work; when it is requisite to speak of the class in connection with others, which are ordinarily and most conveniently designated by English names.

Mammals (as the Bats) being able to fly like Birds, whilst some Birds are confined to the ground, like Mammals.

6. From Reptiles, again, Birds differ in possessing a heart with four cavities and a complete double circulation; the heart of Reptiles being furnished with only three cavities, and the circulation being so arranged, that only a part of the blood sent to the system has been exposed to the influence of air in the lungs: and whilst the temperature of the bodies of Birds is kept up to a certain high standard, that of Reptiles varies with that of the surrounding air, and is usually but little above it. There is the same difference, too, in their mode of life, between Birds and Reptiles, as between Birds and Mammals; with this addition,—that Birds are the most active and energetic in their movements, of all the vertebrated classes; whilst Reptiles are the most inert and sluggish. Between Birds and Fishes, the differences are still greater; for though they agree in being oviparous, they are adapted for an opposite mode of respiration, the latter breathing by water, whilst the former breathe by air; the circulation of Fishes, too, is much simpler in its plan, the heart having but two cavities; and the construction of their skeleton is such, as to adapt these animals to rapid movement through a dense element, water, in which they float without effort, instead of enabling them to raise and sustain themselves in the comparatively unresisting air.

7. It appears, then, that a close *affinity* exists, between Birds and Mammals on the one hand, and Birds and Reptiles on the other. And we shall hereafter see, that this affinity is rendered still more close, by the existence of certain species, in which the characters of the respective classes to which they belong, are so shaded off (as it were), and so blended with those of the neighbouring classes, that we pass without any very abrupt break, from one to the other.

8. But it is not only in marking out these principal groups, and in enabling us at once to know their points of general agreement, as well as their most important differences, that classification is useful. For the principal groups, or *Classes*, are subdivided into others, termed *Orders;* every one of which contains an

assemblage of species, that possesses certain points of agreement, less striking than those which characterise the class, but enough to distinguish each group from others having the same general structure. Thus among Birds, we have the Birds of Prey, the Perching Birds, the Climbing Birds, the Running Birds, the Scratching Birds, the Wading Birds, and the Aquatic Birds; each of these orders being known by some peculiar form of the bill and legs, which distinguishes it from the rest, and which is common (though often with great modifications) to all the Birds contained in it.—With the peculiar forms of the bill and legs, which especially distinguish the order, and which show its adaptation to some particular kind of life, we have certain other characters combined. Thus the Rasores, or Scratching Birds, which feed upon grains or seeds, live for the most part upon the ground, whence their food is obtained; their bodies are heavy and their wings short, so that they cannot rise in the air without difficulty; and they are all furnished with a gizzard, or stout muscular stomach, for grinding down their food. On the other hand, among the Birds of Prey, which obtain their food by pursuing other birds in the air, we find the body and wings adapted to active flight; and the stomach destitute of thick muscular walls, as the nature of the food introduced into it renders it much less difficult of digestion, than that on which the Fowl tribe is supported.

9. In like manner, Orders are subdivided into *Families*, upon characters of still less importance,—such as minute differences in the form of the feet and bill, or in the arrangement of the wing-feathers; but these differences are always connected with something in the internal structure, and in the habits of the tribe, that shows it to be really distinct from others, which it may strongly resemble in general appearance. Families, again, are divided into Genera; each of which includes a number of Species, whose points of difference are very slight, whilst their points of agreement include all the characters which are of any importance. Thus we find that each *Genus* commonly includes a number of *Species*, differing from each other (it may be) in little else than size and colour, and agreeing in every other respect; thus of the

genus *Linaria* or Linnet, there are in this country alone, five species, the green linnet or greenfinch, the brown linnet, the mountain linnet or twite, the smaller redpoll, and the mealy redpoll,—the habits, food, and general conformation of all being very nearly the same,—whilst there are differences between them sufficiently constant to prevent their ever being confounded. But the genus Linaria is united with many other genera, which are chiefly distinguished from it by some slight variations in the form of the bill, into the family of *Fringillidæ* or Finches; which includes the well-known Goldfinch, Hawfinch, Bullfinch, Grosbeak, Sparrow, Chaffinch, Brambling, and many other birds, all having a stout conical bill, slightly bent down near its point. This family,—with others in which the shape of the bill and the general formation of the body, are more or less unlike what is seen in it,—constitutes the section *Conirostres* (or conical-billed birds) of the order *Insessores*, or Perchers.

10. Thus it is seen that, as we pass up from species to genera, from genera to families, from families to orders, and from orders to classes, the characters of agreement become fewer and fewer: whilst those of difference manifest themselves more and more strongly. And when we arrive at classes, we may generally say that the points of difference are stronger than those of agreement; so that, if two animals belong to distinct classes, they may be considered more *unlike* than they are *like*; whilst, if they belong to the same class, they may be regarded as more *like* than they are *unlike*.

11. One other example may be introduced, to show the utility of even a very moderate knowledge of the principles of classification, in enabling us to retain and apply a large amount of information; which, if we had to derive it from the study of each individual animal, could scarcely be embraced by a single mind. The Common Dog is a species of the genus *Canis*, belonging to the family *Canidæ*, of the order *Carnivora*, of the class *Mammalia*, of the sub-kingdom *Vertebrata*. The information conveyed to us by these last terms has already been noticed. From the simple name *vertebrated* animal, we learn that it has an internal skeleton, with a jointed backbone and skull, containing

the spinal marrow and brain, the centres of the nervous system; and that it has five senses, four extremities, red blood, &c. &c.: whilst the knowledge that it is one of the class Mammalia further implies, that it is a warm-blooded animal, breathing air, possessing a heart with four cavities, a complete double circulation, producing its young alive, nourishing them afterwards by suckling, and having the body more or less completely covered with hair. By being able to refer it to the order Carnivora, we know that it is a beast of prey (in its natural state), adapted by the formation of its teeth and digestive apparatus to feed upon animal flesh, and by the structure of its extremities to pursue and attack the animals which serve as its prey. As one of the family Canidæ, we know that it agrees with the Wolves, Foxes, Jackals, and Hyænas, as well as with the Cats, in being *digitigrade*, that is, in walking upon the ends of the toes, instead of upon the sole of the foot, as does the Bear: but it agrees with the former animals, and differs from the Cats, in not being so much adapted to pursue and attack living prey, as to feed upon the flesh of animals already killed;—the teeth not being formed so exclusively for cutting and tearing, as are those of the Feline or Cat tribe; and the claws not being either so long and sharp as theirs, or capable of being pushed forth and withdrawn, as in the Cats. The dog differs from the Fox and Hyæna, in certain peculiarities in the form of his teeth; but his relationship to the Wolf is so close, that many naturalists consider them both to have sprung from the same stock. Hence, while the Dog belongs to a *genus* distinct from the Hyæna and Fox, it is included with the Wolf and Jackal in the same generic character; and it may be, that it does not even constitute a species distinct from the Wolf.

12. There is frequently great difficulty, in Zoology as well as in Botany, in distinguishing *species* from *varieties*. Any two races of animals are considered to be of *distinct species*, which are marked by characters of difference that are *constantly* exhibited; so that neither shows any tendency to lose its own peculiarity, or to acquire that of the other. Thus, notwithstanding the variety of forms exhibited by the several races

of Dog, we never see any which present so strong a resemblance to a Fox, as to be at all in danger of being mistaken for that animal; and they may always be distinguished by this obvious character,—that the *pupil* of the eye of the Dog is always round, whilst that of the Fox is oval when contracted (ANIM. PHYSIOL. § 533). When such constant distinctions are found to exist, the Zoologist has a right to assume that they always *have* existed; and consequently that the original parents, or the stocks whence the races originated, were also distinct.

13. But whilst some characters are constant in each race, others may undergo great variation; so that, within the limits of one species, we may have a large number of *varieties* or *breeds*, marked by differences much greater than those which, in other cases, are held sufficient to distinguish species. This is especially

FIG. 1.—THE HIGHLAND GREYHOUND.

the case with our various domesticated animals; and indeed it is in great part from the power which their constitutions possess,

of adapting themselves to changes in the circumstances of their residence, mode of life, &c., that their utility to Man arises. There is none which shows this more strongly than the Dog, which is the companion of Man in every part of the globe, and which presents more striking varieties of form than any other species. Not only do the different races of Dogs vary in the colour and quantity of their hair, but also in the proportions of the different parts of their body (which is shown as much in their skeletons as in the living animals), and even in their instincts, which in most animals are invariable. Look, for example, at the Grey-

Fig. 2.—Cuban Mastiff.

hound (Fig. 1) and the Mastiff (Fig. 2), the Bloodhound (Fig. 3) and the Spaniel (Fig. 4)! We should scarcely imagine that any period of time, any external influences, could convert one into the other. Yet the Zoologist has no hesitation in affirming that they had a common origin; since it is found that their distinct forms are preserved, only so long as they are matched in breeding with forms of the same kind. For if the different races of Dogs are allowed to breed promiscuously together, and escape from the influence of Man, returning to their original savage mode of life, the varieties gradually disappear, and the races all blend together, after a few generations, into one common type, which

probably resembles that from which the various breeds at first originated. This change has taken place in various parts of the

Fig. 3.—The Bloodhound.

world, in the case of Dogs which were introduced from Europe, and which have since become wild; but it has been particularly

Fig. 4.—The Spaniel.

noticed in Cuba, where the exact period at which the Dog was first introduced,—that of the invasion by the Spaniards at the

end of the fifteenth century,—is known. There is good reason to believe, that the Dingo or native Dog of Australia (Fig. 5) is the descendant of a race once domesticated, which has returned to its wild state; since there are many considerations which induce the Zoologist to believe, that it was not a native of New Holland. Hence there is no difficulty in reconciling the diversities actually existing among the various races of Dog, with the idea of one common form, of which they are modifications. When and how the several breeds first arose, is less easily determined.

14. The question, whether the Wolf and the Dog had a common origin? or, rather, whether the Wolf was the original form of the Dog? is one of great interest, and affords another valuable illustration of the topic under discussion. It is maintained by many Naturalists, and with much probability, that they are the same; and chiefly for the reason, that the peculiarities of form and character usually regarded as distinguishing the Dog from the Wolf, show a tendency to disappear in those races, which have long been accustomed to a savage mode of life. This is especially the case in the Australian Dingo, which has probably

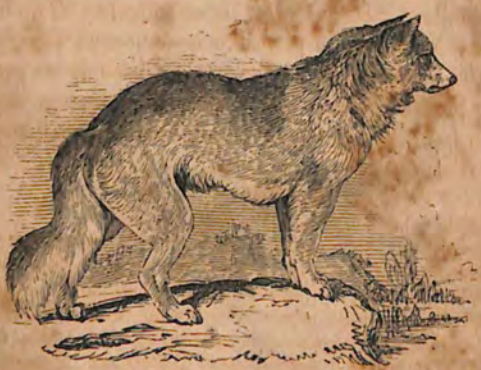

Fig. 5.—Australian Dingo.

lived in this unreclaimed state longer than any other known race of wild Dogs; but it is also true of the Dhole of India, and of two partially tamed races, which are known in North and South America. "These races, in different degrees, and in a greater

degree as they are more wild, exhibit the lank and gaunt form, the lengthened limbs, the long and slender muzzle, and the great comparative strength, which characterise the Wolf; and the tail of the Australian Dog, which may be considered as the most remote from the state of domestication, assumes the slightly bushy form of that animal*." All these wild races, too, have more or less completely lost that common character of domestication—variety of colour and marking, and have assumed a uniform dull-brown hue, much resembling that of the common Wolf. It has been objected, that the Wolf does not exhibit that character, which is so remarkable in all the races of the Dog—attachment to Man. Even the wild breeds of Dogs are easily brought under subjection, and are made useful to him in various ways; which could not be the case, if they had the same savage disposition as the common Wolf. But it has been shown, that the Wolf is much more capable of domestication than is commonly supposed, if taken young from its wild state, and brought up under the influence of Man; and that it then displays as much attachment to its master, and remembrance of kindness shown to it, as any Dog could do. So that there is no difficulty in understanding how, by a continuance of this influence through successive generations, the character of the race may become so permanently changed, that the traces of former domestication may not be altogether lost, even in breeds which have returned to their wild state for centuries†."

* Bell's British Quadrupeds, p. 197.

† The question as to the identity of species between the Dog and the Wolf cannot be regarded as yet settled one way or the other. It will probably be determined by more positive information upon some points, respecting the propagation of the two races, which have not been satisfactorily ascertained. Thus, if the period during which the female goes with young is the same in the Wolf as in the Dog (63 days), as it appears to be from the observations of Hunter and Desmarest, it will be a powerful argument for the identity of the species; but, if it is different, it will almost certainly prove the species to be distinct; since this is a character in which the variation is very narrowly limited. Again, it is well known that the Dog will breed with the Wolf, and that the offspring will breed again with either of the parent races; but it will require to be ascertained, whether the offspring of the Dog and the Wolf will breed with another hybrid of the same kind. If it does, the identity of the species of its parents is almost certain; if it cannot, a powerful argument is afforded for the separation of the two races as distinct species.—(See VEGET. PHYSIOL. § 454.)

15. Now, if we turn to other tribes of animals, we shall find that races exist, in which the tendency to variation is so slight, that differences between two animals, far less in degree than those which exist between the *breeds* of Dogs, are quite sufficient to serve as distinctions of *species*. Thus, among the Feline or Cat tribe, the resemblance between most of the species is so great, that, excepting in regard to their size, it is not easy to detect any differences between their skeletons; that of the common Cat, for instance, being almost precisely a miniature representation of that of the Tiger. Even in species so different in external appearance as the Lion and Tiger, the form of the skull is so nearly the same, that there is no constant mark by which they can be distinguished. Yet these several species, nearly allied as they seem, never exhibit any tendency to assume each other's characters, or to lose their own; but preserve their respective forms, and even the markings on the skin, unchanged, from generation to generation. The only species in which there is any decided tendency to variation, is the domestic Cat; of which, as is well known, there are several breeds. But these races differ much less from each other, than do the different breeds of the Dog; and the variations chiefly consist in the length and colour of the hair. But in the other Felines, even these characters remain so constant, that certain stripes and patches are repeated, generation after generation, upon each individual; and thus afford grounds for regarding as distinct species, any races between which marked differences exist, even of so trifling a character. These have not been subjected to the influence of domestication, for the simple reason, that they do not seem capable of it; their ferocity not being subdued by confinement, nor softened by kindness; and their constitutions not being endowed with the power of adapting themselves to those variations of temperature, food, habits, &c. which animals that are brought into subjection to Man must undergo.

16. Upon grounds as trifling (in appearance at least) as these, the Zoologist feels himself justified in marking out as distinct species, in other groups of Animals, those which present constant differences, however insignificant, whilst under like cir-

cumstances. Thus there are many species of Moths and Butterflies, which are only known apart by certain spots of colour upon their wings; but these, being always found in the same situation, and of the same hue, are justly regarded as sufficient characters for the distinction of species. But on the other hand, if there be any difference in the circumstances under which the two animals are found, it is necessary to ascertain how far the variation may be due to this cause. Thus, most Birds undergo a change of plumage according to the season of the year; and until these changes are thoroughly known, we are in danger of considering as distinct species what are really identical. For if we were to compare one bird in its winter dress, with another of the same species in its summer plumage, we should often find the variations sufficiently great to induce us to regard them as distinct species, if we did not trace their respective histories. In regard to the birds which constantly inhabit our own country, this has been accurately done; but there are many species that migrate to distant countries, either to spend the winter in a warmer region, or the summer in a cooler one; and in regard to some of these, there is still much doubt,—certain birds being known in one country by one plumage, and again in the other by a different one,—and sufficient evidence, whether they are of the same or of different races, not being always obtainable. Even between the northern and southern parts of one extensive district,—such as India,—there will be occasionally found such differences in the plumage of their feathered inhabitants, as would lead to their being regarded as distinct species, if there were not evidence to the contrary, derived from the intermediate forms presented by the birds of the intervening country.

17. Thus it is seen, that the discrimination of species is often a matter of the greatest difficulty to the Zoologist; and the sources of error which have been mentioned, are by no means the only ones. We have hitherto noticed only those variations, which may be produced by the influence of external conditions, or of a natural tendency to variation, such as is particularly evident in the domesticated races. But there are most

striking variations in many animals, not only in the size of the body, but in its form and structure, at different periods of life; and also, not unfrequently, a great want of resemblance between the two sexes. In some instances, there is a positive metamorphosis, or change of form, between the early age of the animal, and its adult or complete state; this is the case in the Frog tribe, in Insects, and in many of the lower classes. No one who might be unacquainted with the history of these changes would hesitate in regarding the Caterpillar as belonging, not only to a *species*, but even to a *class*, distinct from the Insect; or in separating the Tadpole from the Frog; and yet, by due attention to the *history* of these animals, we come to know that one is transformed into another widely different.

18. Now, although Zoologists are tolerably well acquainted with such changes of this description as take place among the higher classes, yet their knowledge is still by no means so perfect of the metamorphoses of the lower. Thus it is not very many years since satisfactory evidence was obtained, that the *Zoea*, a little crustaceous animal, long regarded as forming a genus by itself, is nothing else than the young of the common Crab; and that an animal very closely resembling it undergoes a still more extraordinary metamorphosis, in order to assume its ultimate form of the Barnacle. But even where no such well-marked changes occur during the period of growth, there are often variations which would be held to distinguish species, if we were not aware that the two forms are really the same, in different states. Thus, in almost all Birds, the plumage of the young male is different from that of the adult; sometimes resembling that of the adult female; but often being different from that of either parent. Even here, then, we should be in danger of falling into error, by separating as distinct species what are

Fig. 6.—Early Form of the Crab.

really the young and adult states of the same, were we not to study the animal through its whole period of life. The same is the case, too, in regard to Fishes; the markings on which undergo a similar variation; so that it has been only lately ascertained with certainty (the difficulty of observation being here greater) that the Salmon-Parr is the young of the Salmon, and not a distinct species, as it was long considered. Among Shells, similar difficulties exist,—the young being often very different in form from the adult (as will be shown hereafter), so as only to be identified with it as the same species, by comparing together a number of specimens in different stages of growth. Such a series is, of course, more difficult to obtain among fossils, than among shells of existing races; and it is consequently very often difficult to speak with certainty, as to whether two fossil shells are of the same, or of different species. In some groups, on the other hand, there is such a similarity among the different shells, and such a gradual passage from one form to another, that it is very difficult to say, from the shells alone, whether any distinction of species exists at all. It is to be remembered that the shells are only the external skeletons, thrown off from the surface of the animals which form them; and that it is consequently not at all safe to judge from them alone; since differences may exist in the animals, where the shells do not manifest any.

19. The difference of sex, too, is often marked by such differences in the form and colouring of the body, and even in the shape of parts which might have been expected to be alike in the male and female of the same species (the *antennæ* of insects for example), as may often perplex the Naturalist. Thus, it is well known, that, among Birds, the male is usually larger and more vigorous than the female, his plumage gayer, and his song more powerful and varied; and, where the head has any distinctive crest of feathers, this is often wanting in the female. Among Mammals, too, there are several species in which horns are confined to the male-sex; and in the Lion we have a familiar instance of the difference of aspect between the male and female, caused by the greater quantity and length of the hair on the head and neck of the former. Among Insects, again, there are

many differences of this kind in the markings of the surface; but others of a still more important character are often met with. Thus, there are some species, in which the females are destitute of wings,—as is the case with the common Glow-worm; and others, in which her form is quite different from that of the adult male (although the young of the two sexes correspond),—of which we have an example in the Cochineal insect. But even these differences are surpassed by those which are met with in other classes. Thus among the lower Crustacea, there are several species, of which only females have been hitherto discovered; whence, it is probable, that the males possess an entirely different form, and have not improbably been described as members of some other group. In the curious *Lernæa* (p. 51), the male is much smaller than the female, and differs so much in form, that its true character was long unknown.

20. From these facts we are led to perceive, how much knowledge is required by the Naturalist, before he determines upon the arrangement of the different forms of animal life which he has collected, into distinct *species*,—the first step in classification. It is not sufficient that, on comparing together two animals which bear a strong general resemblance to one another, he finds some obvious point of difference. He must ascertain whether this difference invariably manifests itself, in the races to which these animals respectively belong; or whether it is a mere individual peculiarity. Thus, Men with six fingers and six toes are occasionally to be met with; but we should not on this account rank them as constituting a species distinct from ordinary men, since both the parents and offspring, the brothers and sisters, of such persons, are very commonly found to have only the usual number. Yet, a variation of no greater amount among many of the lower tribes,—especially Insects,—would be a sufficient distinction, not only between different species, but between different genera, or even families.* But, even supposing that such variations do appear constant, it is further necessary to ascertain, whether they have always been so, or whether they

* Thus the great order, *Coleoptera*, or Beetles, is divided into sub-orders, according to the number of joints in the foot.

have arisen from some unknown cause at a former period; from which sprang different *breeds* or *varieties*, such as those of our domesticated animals; and of which the cessation permits the race to return to its original form, as takes place to a certain degree when domesticated animals resume the original habits of their kind.

21. It will be further necessary, that the Naturalist should know the changes of form, which the animals he is considering may undergo, in the progress of their growth and development; so as not to separate as distinct species, those which are but different stages of the same. And he ought, further, to be acquainted with the forms of both sexes; and with the changes in aspect which they may undergo, from the influence of season, climate, &c. In fact, the *whole history* of every species of animal *ought* to be known to the Naturalist, before he begins his arrangement; and as this is very far from being the case at present, it is obvious that there is the widest scope for the labours of any amount of observers, and that many corrections will have to be introduced into the arrangements which Naturalists have formed. In fact, these arrangements must be regarded, in many instances, as *provisional* or temporary; to be confirmed, or set aside in favour of some other more perfect, by increased knowledge.

22. Hence, the greatest encouragement may be offered to those who are commencing the pursuit of Natural History, on however limited a scale; for every one, who observes accurately, and (still more) who collects and arranges facts with the guidance of sufficient previous knowledge, is rendering a service to Science. Even those who are entirely ignorant of Zoology may do much in this way; but their chances of error are great; and they should be careful to record what they actually see, carefully separating from this the inferences or reasonings which they have founded upon it. But those who have some previous knowledge of the Science may do much more; for they are guided by it *how* to observe, and *what* to observe. The pleasure which is derived from a country walk, or from a visit to the sea-coast, is thus enhanced beyond all conception. A very moderate amount of

acquaintance with Botany and Entomology will direct the rambler among the fields and lanes, to many objects of great interest, which the ordinary observer would pass unnoticed ; and the inspection of the haunts of the marine tribes, will frequently lead the Naturalist, who may have previously paid them but a very superficial attention, to spectacles of the rarest and most unexpected beauty.

23. There are many reasons why it is desirable to gain a *general* acquaintance with Zoology, before taking up any single branch as a regular object of pursuit. In the first place, the interest which is derived from the cultivation of the science, is very much increased, by the wideness of the field which is thus embraced. To the mere Entomologist, the Birds, the Reptiles, the land and fresh-water Shells, which he meets with in the course of his insect-hunting rambles, are but as inanimate objects, instead of furnishing him with a number of new subjects of interest. The mere Ornithologist, in like manner, by confining himself exclusively to Birds, misses various sources of gratification, which a small amount of knowledge of other branches of Natural History would enable him to derive from the observations to which he would be led, during his pursuit of the feathered tribes; and the mere collector of Shells, who thinks of nothing but the completeness of his cabinet, not only misses the opportunities of adding to our very limited knowledge of the structure and habits of the animals which form them, but also loses a large amount of pleasure, which he might derive from the observation of the structure and habits of the animals, that he would meet with in the same haunts. Of the advantage of a *general* interest of this kind, to those who pursue Natural History for the sake of the healthful and agreeable occupation which it affords to the mind, and the store of interesting information which it opens to its grasp, we cannot have a better proof than the pleasure which is derived from the perusal of the simple record of such observations, in such works as White's Natural History of Selborne, Knapp's Journal of a Naturalist, Gosse's Canadian Naturalist, and Jesse's Gleanings in Natural History. And to those who make some particular branch of Natural His-

tory their professed object of pursuit, it is equally advantageous to gain a previous knowledge of the general plan of the Animal Creation; since the characters of any particular division of it are thereby much more completely understood,—relations and analogies of the greatest interest are discerned, which would have been otherwise overlooked,—and the labour bestowed, whether on the examination of the structure, or on the systematic arrangement, of the animals particularly sought for, is rendered much more successful, by the guidance received from even a very moderate general acquaintance with Zoology.

24. The principles upon which Classification should be founded in Zoology, are now generally admitted. It is not, however, always easy to apply them. All Zoologists aim at constructing a *Natural System;* that is, a system which shall most fully develope the general *plan* upon which the Creator has formed and arranged the almost numberless species of animals, which owe their existence to him. Now, this system must be constructed in Zoology, as in Botany, by the careful examination of the *whole* conformation of each species (Botany, § 486); and by not resting satisfied with superficial resemblances as indicating affinity, or with variations of a really trivial, though perhaps very striking, kind, as proofs of dissimilarity. Thus, for example, by the uninformed, the Whale and its allies are commonly associated with the class of Fishes, to which they bear a very obvious resemblance in their aquatic habitation, and in their mode of propulsion through the water; whilst they are supposed to be distinct from the Mammalia, with which they really correspond in all the characters on which the Naturalist lays most stress, because they live in a different element, and have bodies formed like those of Fishes.

25. Now, here we are led to perceive the difference between characters that are *essential*, and those that are merely *adaptive*. The *essential* characters, by which different classes are separated, have all reference to the mode in which some or other of the most important vital functions are performed. Thus, true Fishes breathe by means of gills, in which the blood is sufficiently acted on by the air that is contained in the water around them: on

the other hand, Whales breathe by means of lungs, which require to be filled with air from the atmosphere; so that these animals are obliged to come occasionally to the surface to breathe. Thus, the function of *respiration* is conducted on a plan entirely different in these two groups. Again, the heart of the Fish has only two cavities, and the blood does not return to it after passing through the gills, but is immediately distributed to the body: whilst the heart of the Whale has four cavities, and the blood returns to it after passing through the lungs. Hence, the plan of the *circulation* also is entirely different in the two classes,—being *single* in the one, and *double* in the other. Again, the blood of the Fishes is *cold*, and that of the Whales is *warm*; another character of great importance, in regard to the relative activity of the vital operations in general, in these two classes respectively. Further, Fishes are *oviparous*, propagating by eggs, from which the young come forth in due time, with little or no attention on the part of the parent; whilst Whales are *viviparous*, producing their young alive, and nourishing them afterwards by suckling. There are also many other points in the formation of the skeleton, the nervous system, the organs of secretion, &c. in which the Whales differ entirely from Fishes, and correspond with Mammals; and these embrace all the *essential* particulars of their structure and physiology.—The points of resemblance are only *adaptive*; being such as enable the Mammal to become an inhabitant of an aquatic element. For if we were required to modify a Mammal, in such a manner that it might lead the life of a Fish, we should necessarily alter the form of its body, so that it might be enabled to swim through the water with as little resistance as possible; and we should also adapt its instruments of propulsion to the new medium in which they are to act, and in which the feet of a terrestrial quadruped would be quite useless to it.

26. Hence, then, in a *natural* arrangement, Whales are placed among the Mammals, as agreeing with them in all essential characters; although their external forms, and their mode of life, are so different. To place them with Fishes, on account of their resemblance in external aspect, would be to adopt an *artificial* principle of classification; that is, a principle which leads us to

associate the different groups of animals from their correspondence in some one or two simple and easily-recognised characters—all the rest being neglected. By following out such a principle, we should not only class Whales with Fishes, because they inhabit the water, and have their bodies formed for swimming, but we should also place the Bats among Birds, because they fly, and group together a great many Reptiles and ordinary Mammals, because they walk upon four feet. No such classification could be of the least use; and, consequently, all artificial systems have been long given up in the arrangement of the Animal Kingdom,—Zoologists applying themselves to the completion of a Natural Classification, in which every animal may be placed among those to which it bears the greatest general resemblance, and in which its relations to others may be exhibited.

27. There are great difficulties attending the completion of such a System, however, arising from various causes. In the first place, of the whole number of animals at present existing on the surface of the earth, a large proportion are probably as yet altogether unknown to us. This proportion is less, however, in some tribes than in others. Of the larger *Mammals* or *Reptiles*, for instance, it is not probable that many living species remain to be discovered; yet, of the smaller species, it is certain, that a large number must be residents of countries which have been as yet but imperfectly explored. This is still more the case in regard to *Birds;* and of the whole number of species of *Insects*, which people our globe, we may safely affirm, that but a small proportion have been yet collected by Entomologists, although the amount of those at present contained in their cabinets probably far exceeds 100,000. The reasons are obvious why so little, comparatively speaking, has yet been done for this department of Zoology, notwithstanding the number of persons engaged in the pursuit of it; for the small size of the greater number of the objects it embraces, causes them to escape the notice of ordinary observers; added to which, there are many species that only exist in their perfect state during a few days or even hours, and are consequently very liable to elude the vigilance of the most diligent Entomologist. Of the animals which inhabit the

ocean, or live on its borders,—the various tribes of Fishes, Mollusca, Crustacea, Worms, and Zoophytes,—the proportion which yet remains to be discovered is doubtless very large. Even on the coasts that have been most thoroughly explored, new species are continually being discovered; and these are often very dissimilar in form to any previously known, presenting both to the Naturalist and to the Physiologist many points of the greatest interest.

28. But it is not only in the extension of our knowledge of existing species, that much yet remains to be accomplished, before the foundation of a Natural Classification can be regarded as securely laid. No system can be complete, which does not include those that formerly tenanted the globe, as well as those that at present inhabit it. A very slight knowledge of Fossil Zoology is sufficient to convince the Naturalist, that the animals which peopled this earth in its earlier ages were constructed upon the same general principles as those now existing upon its surface; so that it is safe to reason as to the portions of their structure that are *not* preserved (which is generally the case with regard to their softer organs), by comparing those which *are* with the corresponding parts of animals now living. Frequently it is found that peculiar forms of structure, which are at present exhibited in but few and comparatively insignificant tribes, were formerly displayed in races, which must have possessed, from their number and power, the predominance over all the rest at that epoch. This is the case, for instance, in regard to the Saurian (lizard-like) Reptiles, and the enamel and bony-scaled Fishes. Hence we should not understand the true station of these as natural groups, from those species alone which at present exist; these being only the few and feeble remnants, as it were, of the numerous and gigantic races which they represent. Still more frequently does it happen, that gaps or deficiencies exist in the groups, which are formed by bringing together existing animals alone; and that these groups are completed, and are connected with others apparently far removed from them, by species which existed in ages long since past, and whose fossil remains are preserved to us, as if for the very purposes of the Zoologist. Thus, for example, the order PACHYDERMATA, in the

class Mammalia, includes a small number of large animals—the Elephant, Rhinoceros, Tapir, Hippopotamus, &c.—which stand completely apart, as it were, from each other, not being connected by intermediate forms. But these forms are abundantly supplied by the numerous species, of whose former existence we have ample evidence.

29. The principles on which most of the leading forms have been constructed, in the higher classes at least, are now so well understood, that the Zoologist has no difficulty in determining the general characters, habits, &c., of the animals which long since tenanted the globe and its waters; from the comparison of the structure of their hard parts, with those of the existing species to which they are most nearly related. And so far may he carry this reasoning, that, from the extremity of a single bone, he may re-construct, as it were, in his imagination, the entire animal; and may form an accurate judgment of its size, figure, conformation, and even of its habits. This has been often tested by the discovery of perfect skeletons of animals, which had been previously known only from small fragments, but of which a very complete account had been given from these by a sagacious Naturalist. For the development of this important principle, the Science is indebted above all to the immortal Cuvier, whose future reputation will be founded much more upon his researches into the History of Fossil Remains, than upon his Zoological Classification, which is continually undergoing great modification. By the late microscopic inquiries of Professor Owen, it has been shown that the minute structure of the *teeth* of Vertebrata is capable of affording characters of the most important nature in the determination of fossil animals; often supplying the means of ascertaining, by the examination of an unformed fragment of a tooth, not merely the class and order, but even the family and sometimes the genus, to which the animal belonged. Prof. Quekett has shown that similar inferences may be drawn from the minute structure of the *bones* of Vertebrata; and the Author has arrived at like results, from the examination of the *shells* of Mollusks and Echinoderms.

30. But Fossil Remains are sometimes found, which perplex the most accomplished Zoologist; their dissimilarity to all the forms of Animal structure with which he is familiar, being such as to leave him very much in the dark, as to the true characters and positions of the animals, of which they are the sole representatives. It is probable, however, that the progress of discovery will bring to light new facts regarding their structure; either by affording more complete specimens of the remains themselves, by which it may be better understood; or by disclosing to us some points in the structure or history of existing animals, which shall unveil the close relationship that they may really bear, although this is at present obscured by superficial differences (§ 32). In this manner, therefore, we may expect that many spaces in our Classification will be hereafter filled up, which at present appear to be altogether blank.

31. It is not only, however, from the incompleteness of our knowledge of the various kinds of Animals, at present or formerly existing, that the foundations of a sound Zoological classification are as yet very imperfect; for of a large part of those, with whose external forms the Naturalist is familiar, the internal structure has been but very imperfectly, or not at all, investigated. Hence, a great part of their arrangement into groups is founded upon a small number of characters only; and not at all upon that *general* comparison of them, which alone can securely indicate their real relationship. There is, consequently, a field for investigation, in this department alone, which may occupy an almost unlimited number of inquirers for a very long time: and any such systematic examination, even of very common animals, if prosecuted with a sufficient amount of guidance from previous knowledge, would be attended with the utmost advantage to science. And it is not only in determining the true relations or *affinities* of species or of groups which are known to be nearly allied, that this kind of knowledge is available; for it often serves to indicate the most unexpected and beautiful *analogies*, between groups far distant from each other, but occupying a corresponding place in their respective classes. Thus we shall

find many points of analogy between the order *Carnivora* among Mammals, and that of *Raptores* among Birds; each including those predaceous species, which are especially adapted to capture and devour the weaker kinds; and each having its own particular *type* or plan of structure adapted to this purpose, in a manner that strongly reminds us of the other. It is by the existence of these analogies among distant groups, that the Unity of the Plan of the Animal Creation is most clearly manifested; and every one which we discover affords us a new, and often very striking, glimpse of this design. The most important of them will be pointed out in their proper places.

32. Further, the changes of form which many tribes of animals undergo, and of which we as yet have but a very imperfect knowledge, are often very important in classification; as indicating relations which we should not have otherwise suspected, between different groups. Thus, there is a certain parasitic animal of very strange form, which attaches itself to Fishes, and is named *Lernæa* (Fig. 7); the true position of which in the animal scale was not known, until it was ascertained that it passes through a *larva*, or imperfect state (Fig. 8), in which it bears so very close a resemblance to the larva (Fig. 9) of the *Cyclops*

Fig. 7.—Lernæa.

Fig. 8.—Larva of the Lernæa.

Fig. 9.—Larva of the Cyclops.

Fig. 10.—Cyclops.

(Fig. 10),—a little animal common in pools, and known under

the name of Water-flea,—that their real relationship is apparent. In fact, they may be said to have been originally formed on the same plan or type; but to have afterwards departed from it, —each in a different direction,—so as to become very unlike one another in their adult forms. A still more striking illustration may be derived from the metamorphosis of the animals of the class of *Cirrhopods*, or Barnacle tribe (Figs. 11 and 12). These were formerly placed among the Mollusca, on account of their resemblance to that group, in having their soft bodies enclosed within shells, in remaining constantly attached to some other object, whether fixed or floating, and in the absence of any distinct division of the body into segments. But it was pointed out by Cuvier, that the arrangement of the arms and of the nervous centres is such, as to entitle them to a place in the Articulated, rather than in the Molluscous series,—that is, to be associated rather with Insects, Spiders, and Crabs, than with Oysters, Snails, and Whelks. More recently, it has been shown that they undergo a very curious metamorphosis,—having in their early state a form not very unlike that of the early state of the common Crab (Fig. 6), possessing eyes, and the power of free movement—but afterwards becoming fixed to one spot for the remainder of their lives, losing their eyes, and forming a shell, which, though composed of several pieces, has nothing in common with the jointed shell of the Crab or Lobster. Hence the affinity of the Cirrhopods to the Crustacea, unlikely as it seemed at first, has been clearly demonstrated by these observations.

FIG. 11.—SHELL OF THE BARNACLE.

FIG 12.—BODY OF THE BARNACLE.

33. Now, we shall suppose that these difficulties had been

overcome, and that all the animals forming a particular group had been collected, and their internal as well as external structure carefully examined;—in what way, it may be asked, should we attempt to arrange them? Is it possible to form such a classification, as that they may be placed one after another in a single line or series, uninterruptedly connecting the lowest and the highest forms? An excellent answer to this question is contained in the following quotation from the writings* of a distinguished Naturalist, who has done much for the advance of Zoology; although (in the opinion of the Author) he has erred by not following Nature, but by attempting to apply a *system* of his own creation, or at least founded upon a limited and imperfect generalization, to the arrangement of the Animal series. "Let us suppose," he says, "that an Entomological student, with a well-filled cabinet of unarranged insects, having his mind well stored with those simple facts regarding their structure and economy, which he is to look upon as solid data,—let us suppose him to commence the arrangement of the objects before him, according to what he thinks their true affinities, and with a view of verifying or discovering their natural arrangement. He commences by placing, one after the other, those species which bear the greatest mutual resemblances, and for a time he proceeds satisfactorily,—he finds the several links in the chain, as it were, fit into each other so harmoniously, that he begins to think the task much easier than he at first expected; and that he will not only be able to prove, by these very examples before him, the absolute connection of one given genus to another, but also to demonstrate that the scale of nature is simple,—that is, passing in a straight line from the highest to the lowest organised forms. All these ideas, however (generally resulting from partial reasoning or from limited information), are soon found to be fallacious. As the student proceeds, he meets with some insects which disturb the regularity of his series, and with others which he knows not where

* Swainson's Discourse on the Study of Natural History, in Lardner's Cyclopædia, p. 201.

to place. He still goes on, however, introducing the former in the best way he can, among those to which they have an evident affinity, and placing the latter by themselves, in the hope of finally discovering their proper place. The further he proceeds, however, these difficulties are rather increased than diminished. He remodels his groups, and alters his series; still he cannot reduce all into harmonious order. What he gains by one modification of arrangement, he loses in another; and affinities which were preserved in his first series, are destroyed, that a place may be found for other insects, which seem to have equally strong relations, although in some respects they evidently disturb the order of progression.

34. "But his difficulties do not terminate here; for, admitting the possibility of his success in bringing every species into an appropriate group, the union of these groups among themselves opens a new source of embarrassment. It is plain that, in the order of nature, they must follow one another in some sort; for, if there were no *progression* of development, all animals would be equally perfect—that is to say, would have the same complexity of structure. Here, then, lies his difficulty. He perceives, perhaps, an evident affinity between two groups, by species which seem to blend them together, and to conduct him, by an almost insensible gradation, from one to the other. He therefore concludes this to be the natural series, and he approximates them accordingly. Presently, however, upon looking more attentively to his other unsorted groups, he finds not only one, but several, each of which, in some way or other, shows an approximation just as close to his first group, as that does which he had previously made to follow it; and he is as much at a loss how to dispose his groups in natural succession, as he was how to place the species they contain. The same results also attend his attempts at improving his arrangement of groups; what is gained by shifting one so as to follow another, is lost by dissevering it from that with which it was previously united: until, with all his assiduity and trials, he finds that there is still a remnant of 'unknown things,' which stand disconnected, as it were, from the

series he has formed, and which cannot be made to fall into place by any contrivance he can devise."

35. The difficulties which are thus detailed as existing in the classification of Insects, are equally felt in every other department of Zoology; and they result from this,—that every natural group or assemblage of species, united by certain characters common to all, is connected, not with *two* groups merely, one above and the other below it, but with *several;* and that, of the different modifications which these characters present, a large part are such as to form the transitions from one to another. In every natural assemblage, there is some *one* which presents the characters that are common to them, in a more remarkable and complete manner than the rest—and this is called the *type* of the group. Thus, each genus has its *typical* species; each family its typical genus; each order its typical family; and each class its typical order: the type, in each instance, being that subdivision to which our minds naturally revert, as best exhibiting the characters that belong to the entire group. We may regard the type of each genus as forming its *centre;* and the other species as having their places at a greater or less distance from it, according as they differ from it more or less in their respective characters. Some there are which do not depart widely from the type; whilst there are others which differ from it to such a degree, that we might have failed to recognise the connection, if it were not completely shown by intermediate links. These are called *aberrant* forms. Now, we will suppose the centres or types of these groups to be spread out over a surface, so that each should be surrounded by a number of others most nearly allied to it; we should then find, that we might arrange the different species round these centres respectively, so as to form groups, of which every one shall come into contact with others, by species that blend, more or less completely, the characters of both.

36. The following illustration will, it is hoped, make this matter plain. We will suppose a large territory occupied by a number of distinct tribes of people, whose respective possessions are not separated by any very distinct bounds, but of which every

one is characterised by possessing a dialect peculiar to itself. We will further imagine, that the principal residence of each tribe is in the centre of the district; and it will, of course, be there, that we should expect to find the peculiar dialect of the tribe in the greatest perfection. For those members of the tribe, which live near the borders of the territory, naturally acquire, from intermixture with the borderers of the several other tribes which surround them, some combination of other dialects, whilst their own is spoken with less purity; so that, however easy it might be to recognise, by their difference of speech, the inhabitants of the *central* portions of the respective districts, those that reside near the line which divides one from another do not present the distinctive peculiarity of either, in a sufficient degree to enable us to determine to which they belong.

37. Further, all these tribes may agree in the possession of a common *language*, although they speak different dialects of it; and may be united, by this and by other characters, into a *nation*, to which a certain territory belongs. Other nations, each in like manner composed of several tribes, may inhabit the countries on its borders; and every one may have its capital city in the centre of the region it occupies, where the national characters are most fully displayed, and the language spoken in the greatest perfection. Now the tribes which live near the boundaries that divide one *nation* from another, will have just the same tendency to acquire each other's *national* peculiarities, as the individuals that live near the borders which separate the *tribes* (provided there be no obstacle interposed by the nature of the country), have to acquire each other's minor peculiarities; so that, in travelling from one capital to another, we should not find ourselves suddenly transferred from a people marked by one set of characters, to another presenting a different series; but should be able to trace, as we travel from the capital towards the borders of one kingdom, a gradual shadowing-off of its characters, so that we may enter the other without being aware of any decided change, until we approach the capital in which its national peculiarities are fully displayed. This is very much the case in regard to the division

between England and Scotland; the residents on the two sides of the Border having many of the characteristics of both nations, so that the English character is not fully displayed in the northern counties of England, nor the Scotch in the most southern parts of Scotland. Further, as each nation may be supposed to be surrounded, not by one, but by *several* others, it will have a tendency to blend in this manner with them all; so that of its national peculiarities, some are lost as we pass in one direction, some in another, thus gradually obliterating the differences which may exist between itself and the various peoples that surround it. By this comparison we may represent the manner in which *natural families*, each consisting of several distinct genera, are related to each other; and in which they tend to unite, through links of connection, which are formed by the blending of the characters of two or more in the same tribe.

38. Lastly, we shall suppose all the nations inhabiting one continent, or quarter of the globe, to have certain points of general resemblance to each other, whilst differing in a large number of characters; and that those by which other continents are peopled, also agree among themselves, and differ from the rest in the same manner. Although, in consequence of the more distinct separation between the regions they respectively inhabit, there would not be so much tendency to the blending of the characters of those different races, which live most near to each other on the borders of their respective continents, yet *some* approximation might be expected; and this would take place on the same plan,—the characters of the nations that live on the borders of any continent, partaking in some degree of those of the people of other continents on the opposite side of their respective boundaries. In this manner we may represent the relationships that exist between the *orders*, into which the *families* are united,—or between the *classes*, which are formed by the union of orders,—or between the *sub-kingdoms*, or primary subdivisions of the Animal Kingdom, which are formed by a union of *classes*.

39. It is probable, that *every* natural group, if we were in

possession of *all* the forms which it contains, would present links of transition such as these, towards the groups which surround it. But, for the reasons already stated (§ 27-30), they are frequently wanting, although they are continually being brought to light by the rapid extension of Zoological research. A few examples of this kind may be here adverted to. It has been already stated, that the different *families* and *genera* of the order Pachydermata, widely as they appear to be separated when we look at the existing species alone, are in reality connected most closely by fossil species, which present the most remarkable and interesting combinations of characters, that are now found separately in the forms with which we are familiar. The chief of these will be pointed out in their proper place. The different *orders* of Reptiles, although very distinct as regards their *types*,—viz. Turtles, Lizards, Serpents, and Frogs,—are yet most closely connected together by links of transition, that pass between the typical forms. Thus, between the Turtles (Fig. 13), and Crocodiles (Fig. 14), the passage is established by species of Turtles, which have a long neck, tail, and legs, and a small shell which only covers a part of the back, (known as Alligator-Tortoises,)—and the Crocodiles and Alligators again lead us by an easy transition to the Lizards,

Fig. 13.—Tortoise.

Fig. 14.—Crocodile.

with which indeed they were formerly united in a single group. Again, from the true or *typical* Lizards, which have four legs, we pass to the Serpents (Fig. 15), which have none, by means of such species of Lizards as the one represented in Fig. 16, which have the body and tail very much prolonged, and the legs very short,

or altogether wanting, of which the common Blind-worm or Slow-worm of this country is a characteristic example; for so completely does it blend the external characters of the Lizard and Serpent tribes, that it has been placed by some Zoologists in one, and by some in the other. With the Frog tribe the class of Serpents is connected by a very interesting animal — the *Cæcilia*, or Blind Snake; which has the general form of the snake tribe, but which, in fact, really belongs to the class Batrachia, having a skin destitute of scales, and being found to undergo a metamorphosis, having at one period (like the Frog, &c.) the same form of the circulating and respiratory organs as the Fish.

FIG. 15.—NAIA HAJE.

FIG. 16.—CHALCIS.

40. But the class Batrachia is not connected with the other tribes of Reptiles by *one* link of transition only; for it contains animals which may be regarded as *representing* the Turtles and Lizards in its own group,—just as the Bats represent Birds, and the Whales represent Fishes, among the Mammalia. Thus, there is a species of Frog in South America, whose back is covered

with a hard, horny skin, that reminds us of the shell of the Turtle; and we have in the ponds and ditches of our own country more than one species of the *Water-newt*, (Fig. 17), which has the *form* of the Lizard, whilst, in its metamorphosis and internal structure, it corresponds with the Frog. Among the Lizards, again, there is a tribe that is characterised by its flattened body and Frog-like form. One species of these is seen in Fig. 18; but there are others, in which the tail is shorter, and the body broader, so as still more to resemble that of a Frog. Thus, we have not only the connecting link of the Lizard-like Frog, but of the Frog-like Lizard; the essential characters of one of the groups being preserved in each case, but displayed under the form of the other.

Fig. 17.—Water-Newt.

Fig. 18.—Agama.

41. Of a complete series of transitional forms between two *classes*, moreover, we have a beautiful instance in the case of Reptiles and Fishes. One of these transitions is established by the metamorphosis of the Frog tribe already adverted to (§ 18); but the connection is shown also in certain species, which, even in their adult state, possess both lungs and gills, and which have the whole of their conformation intermediate between that of the true Fishes and that of Reptiles. Of this kind are the *Axolotl* (Fig. 19), which is undoubtedly a Reptile, since the characters of the Reptile predo-

Fig. 19.—Axolotl.

minate over those of the Fish; and the *Lepidosiren* (Fig. 20), in which the characters of the two classes are so completely blended, that Zoologists have not yet agreed on which side it should be placed. Again, the genuine Reptiles are closely connected with Fishes by two very remarkable animals, not now existing, the *Ichthyosaurus* (Fig. 21), and the *Plesiosaurus* (Fig. 22); whose remains abound, in certain rocks, to such an extent as to show that they must have been

FIG. 20.—LEPIDOSIREN.

FIG. 21.—ICHTHYOSAURUS.

formerly very numerous. On the other hand, there are certain species of Fishes (which were more numerous and abundant at for-

FIG. 22.—PLESIOSAURUS.

mer epochs than at present), in whose structure there is much that reminds us of the Crocodiles; the swimming-bladder somewhat resembling a lung, and the vertebral column and ribs possessing many characters in which they approach those of that order of Reptiles. In the Eels, again, we have the form of the Serpent

so exactly repeated, that it is not easy to distinguish the group to which certain species belong, by a cursory glance at their exterior.

42. Lastly, we may advert to an instance, in which even two *sub-kingdoms* are connected, by links of transition so close, that it is not easy to say where one begins and the other terminates. Among the Mollusca, but occupying the lowest place in that division, are usually ranged a collection of animals, which do not possess a shell, but which have their organs enclosed as it were in a bag or tunic; from which they derive the name of Tunicata. Few of them have any considerable power of spontaneous movement; and a large proportion of them are fixed during their whole lives. Many of them are *social* in their habits; that is, a number of them live together, adhering to each other by their external surfaces. But there are some which not only adhere together, but which are more closely connected;—a number being included in one common envelope; or being attached singly to a connecting stem, as shown in Fig. 23.

FIG. 23.—SOCIAL ASCIDIÆ.

Now, in these last cases, they propagate, not only in the manner of the other Mollusca, by the deposition of eggs, but also in the manner of the Polypes, by *gemmation* or budding; for all the animals forming one cluster, or mounted upon one stem, proceed from a single individual, which has thus extended itself in the manner of a Plant. The simplicity of the structure of these animals is very great. The tunic has two orifices, *b* and *a*, through the former of which, water is continually drawn in, whilst through the latter it is as constantly expelled. The liquid enters a large chamber, which may be regarded as a dilated *pharynx* or gullet; and at the bottom of this lies the entrance to the stomach, *e*, from which the intestinal tube, *t*, passes to the orifice of dis-

charge, *a*. Now there is a tribe, known under the name of *Bryozoa*, which presents the same general plan of structure

c *b* *a*

FIG. 24.—PLUMATELLA; *a*, NATURAL SIZE; *b*, A GROUP ENLARGED; *c*, ANAL ORIFICE.

under a form so *zoophytic*, that it has until recently been unhesitatingly associated with the true Polypes (Fig. 24). The most obvious features of resemblance shown by these animals to Polypes, are the plant-like aspect of the composite structures which they form, and the presence of arms or tentacles disposed in a circular manner around the entrance to their digestive cavity. But in the act of gemmation by which their composite structures are formed, they are paralleled (as we have just seen) by many Tunicata. Further, their tentacles are never used like those of true Polypes, to grasp their food and thus to draw it towards the mouth, but are clothed with the vibratile filaments termed *cilia* (ANIM. PHYSIOL. § 117), by whose action currents are created in the surrounding water, which serve to convey the nutritive particles into the digestive cavity. Now in this re-

spect, the resemblance of the Bryozoa is really much closer to the Tunicata and other Acephalous Mollusks, all of which obtain their food by the agency of ciliary currents, than it is to Zoophytes; and further, although most Bryozoa have the tentacles circularly disposed around their mouths, yet in some (as in *Plumatella*, Fig. 24) they are set upon two "lobes" or projections, one on either side of the mouth, so that the radial symmetry by which all Polypes are characterized is entirely lost. It is in the conformation of the digestive apparatus, and in the presence of a rudimentary nervous system distinctly Molluscous in its type, that the relation of the Bryozoa to the Tunicata is most strongly marked; whilst the absence of all trace of a heart and circulating system is a mark of relationship to Zoophytes. Altogether this group may be considered as forming a complete transition between the Molluscous and the Zoophytic series, but to be rather on the Molluscous than on the Zoophytic side of that boundary line, which, in any system of classification, must be drawn between them.

43. It can only be, then, by the careful comparison of the different forms of animal structure, that we can select those, which are entitled to rank as *types* of groups; and it is in this that the skill of the Zoologist is most displayed. Having satisfied himself, however, *which* are to be regarded as *types*—i. e. as presenting their respective plans of structure with the most completeness,—he proceeds to range around these such forms as have a close resemblance to them; placing them nearer or more distant, according to the degree in which the characters of resemblance or of difference predominate; and taking care that the intermediate forms shall be so arranged, as to form links of transition towards the other types, of whose characters they partake. Whenever this process shall have been accomplished for the whole Animal kingdom (as it has been in some degree for certain divisions of it), we shall be in possession of a Natural System as complete as the deficiency in our materials permits it to be.

44. It is a question of the greatest importance in Classification, what characters are to be relied on for distinguishing

species, what for separating genera, what for dividing families, —and so on. To this question no satisfactory answer can be given; not only because similar characters have very different values in two distant classes; but also because, even in groups not remote from each other, they are of very different degrees of importance. Thus in one genus, there may be a certain character, such as *colour*, which is invariably the same in each species; so that species may be distinguished from each other by it alone. On the other hand, there may be certain variations in regard to *form*, which the Zoologist does not regard; because he knows that, in the group in question, there is much latitude in this respect. But in another group, the *forms* of particular parts, even though these be of great minuteness, may be so constant for each species, as to furnish very satisfactory characters for dividing them; whilst the colours may be so liable to variation, that no use whatever can be made of them in classification. Some examples of this kind have been already given (§ 15, 16). Hence, no general rules can be laid down on this very important subject; and in each group of whatever rank, whether it be a class, an order, a family, or a genus, it ought to be ascertained what characters possess most fixity, and what are to be put aside as unfit to be relied on.

45. There are five principal types or plans, upon which the members of the Animal kingdom are constructed; and these plans are found to exert a modifying influence over the conformation of all the organs of the body. The type of the lowest of these groups is generally considered to be that of the simple nucleated cell (see ANIM. PHYS.), which performs all the functions of animal life, although we can find no trace of special organs for the execution of most of them. These animals, to which the name of PROTOZOA is given in allusion to the simplicity of their structure, are those which approach most closely to the plants, in fact between them and the lowest plants it is often difficult to draw a line of demarcation. The type which prevails in the second group is the *Radiated* arrangement; in which the mouth is situated in the centre of the body, and the several organs are disposed around it, so as to give to the whole structure a

star-shaped or a globular form. This we see in the Star-fish (Fig. 25), the Echinus or Sea-Urchin, most of the Jelly-fish,

Fig. 25.—Star-Fish.

and in nearly all the Polypes, when we look at them separately (Fig. 26). Sometimes this arrangement is perfectly *symmetrical;* that is, every division of the body exactly resembles the others in form and size; but in other instances we see that the parts of the structure have a tendency to arrange themselves equally on the two sides of a central line, so as to approach that *bi-lateral symmetry*, or equality of the two halves of the body, which is characteristic of the Articulata and Vertebrata. Those in which the radial or circular symmetry is perfect, are to be regarded as the *typical* Radiata; whilst those in which it gives place to the lateral symmetry, are *aberrant* forms, that conduct us towards other groups. The resemblance of the parts of the body, in Radiated animals,

Fig. 26.—Sea Anemone.

is not confined to their exterior, but extends to the internal organs also; which are so constructed, that each is but a repetition of the rest. Thus, in every arm of the Star-fish, we have not only the same number of the little plates of which the skeleton is composed, and the same arrangement of the small tubular feet which are put out between these, but we have also in each a nervous ganglion and trunk, a prolongation of the stomach, and a set of blood-vessels,—all of which are precisely similar in the several rays.

46. This repetition of similar parts around a common centre strongly reminds us of the arrangement of the leaves in a leaf-bud, and of the sepals, petals, &c. in a flower. (See VEGET. PHYSIOL., chaps. viii. and xii.) In the Polypes, which constitute the largest and most important of the groups exhibiting this plan of structure, a number of individuals, each capable (like a leaf-bud) of living by itself, are arranged on one common plant-like structure (Fig. 27); and this extends itself by *budding*, in the manner of a tree or shrub. It is not only in their external aspect, and in their tendency to form compound structures, that the animals exhibiting the radial symmetry bear a resemblance to Plants; for it shows itself also in the predominance of their *vegetative* over their *animal* life,—that is, in the large proportion which their organs and actions of *nutrition* bear to those of *sensation* and *locomotion*. The greater part of the

FIG 27.—SERTULARIA.

Radiata are fixed to one spot during all but the earliest period of their lives; and though the instruments by which they obtain their food have some power of spontaneous motion, and certain of their actions appear to indicate sensation, yet it cannot be doubted by any one who observes their habits, that they possess these endowments in a very feeble degree. The most active among them are some of the *Medusæ*, or Jelly-fish tribe, which exhibit the greatest departure from the general type of the Radiata, in the bi-lateral symmetry of their bodies; and certain of the *Holothuriæ*, or Sea-Cucumbers (Fig. 28), in which the body

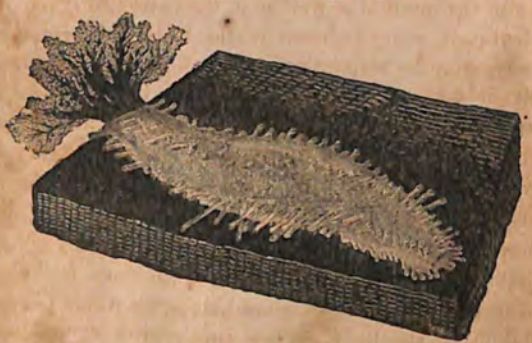

Fig. 28.—Holothuria.

is so prolonged, as to remind us of that of a Leech or Caterpillar; although the circular arrangement of the organs around the mouth shows their place to be in the Radiated sub-kingdom.

47. In the sub-kingdom *Articulata*, there is also a considerable repetition of parts; which, in the lowest of the group, are almost precisely similar to each other. These parts are disposed, however, not around a centre, but in a line,—as in the Centipede (Fig. 29); and there is a most exact similarity between the two halves of the body, or, in other words, a most complete bi-lateral symmetry. There is no internal skeleton; but the hard envelope gives the required degree of protection, and also furnishes points of attachment to the muscles by which the body is moved. Where there are distinct members or limbs for aiding the motions of the fabric, we find that they too are covered

with a jointed envelope. Hence the character of this series is derived from the inclosure of the body and limbs in a jointed envelope; and from the perfect resemblance of the two halves to each other. The repetition of parts is found to exist in great

Fig. 29.—Centipede.

degree in the internal as well as in the external organs. Thus in the Centipede, every segment of the body is provided with its own air-cavity for respiration, and with its own nervous ganglia; and the dorsal vessel, which represents the heart in these animals, is also divided by partitions, into a series of chambers corresponding to the segments. Further, the conformity between the two halves of the body is extremely perfect; for not only are the exterior of the trunk and limbs perfectly symmetrical, but the equality extends also to the organs of digestion, circulation, and respiration, which, with very few exceptions, would be divided into two equal halves, by a line passing down the middle of the body. Now this perfect symmetry, which is seen nowhere else than in the Articulata, is evidently connected with the high development of their powers of locomotion. A little consideration will show, that it is impossible for an animal to move with great energy and rapidity, unless the two sides of its body are equal in power and weight. Every one knows that a Bird, if one of its wings be clipped, cannot fly straight; and that a Man, having a burthen to carry, will accomplish it much better by dividing it into two portions, and raising one with each hand, than by attempting to bear it all on one side. We shall hereafter see that, in rapidity and energy of movement, there are no animals which, when their size is taken into account, can be compared with a large number of the Articulata. The sensory organs, too, are highly developed; and in the construction of the eyes we again meet with the *repetition*, which is so characteristic of the whole organisation; each of the bodies that project

on the two sides of the head being made up of a vast number (often many thousands) of minute eyes, every one perfect in itself (ANIM. PHYSIOL. § 573). The possession of these compound eyes is so characteristic of the Articulata, that any animal in which they were found, might be unhesitatingly referred to that series.

48. The characters that have been enumerated are very far from being all, which belong to the Articulated series as a primary subdivision of the Animal kingdom; but they are the most important, as enabling us most readily to distinguish its members from all others. They will be dwelt upon in more detail in their proper place.—The animals composing the sub-kingdom *Mollusca* are strikingly contrasted with them in a great variety of particulars. In the first place, the body is soft, and has no regularity of form. It may or may not be covered with a shell; but if this exists, it merely serves as a protection to the body, and gives no assistance to its movements; no muscles being attached to it, except such as connect the animal with the shell, or the different pieces of the shell (where there are more than one) to each other. In fact, the entire muscular system consists of a few scattered bands and fibres, except in some of the more active species, which partake of the characters of the Articulata or Vertebrata. But, on the other hand, the organs of nutrition attain a very high degree of development in this series; and the bulk of the body, which is often very considerable, is given almost by them alone. We do not find in *them* any tendency to *symmetrical* arrangement of any kind; nor to a repetition of parts, such as we have seen in the Radiata and Articulata; so that no definite form can be assigned as characteristic of their fabric. An idea of the mode in which their organs are arranged, in the lowest and simplest species, will be derived from the examination of the accompanying figure, which represents the anatomy of the *Oyster*. It will be seen that there is here an absence of anything like a *head;* for the mouth, *b*, is buried, as it were, among the other organs, and cannot be projected from between the valves; and there are no other organs of sense, than the tentacula or enlarged lips, *t*, that immediately surround it.

This is the case with all the animals inhabiting *bivalve* shells; although some of them have a fleshy tongue-like organ, termed

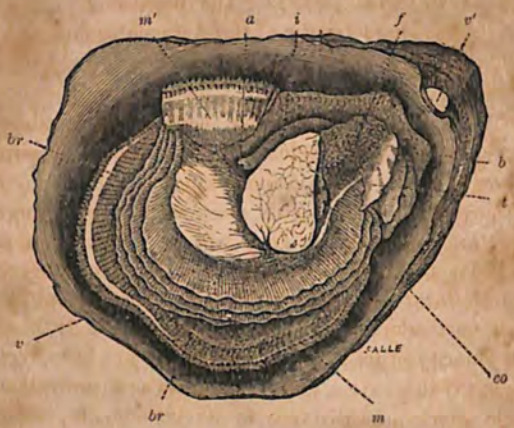

FIG. 30.—ANATOMY OF THE OYSTER.

v, one of the valves of the shell; *v'*, its hinge; *m*, one of the lobes of the mantle; *m'*, a portion of the other lobe folded back; *c*, muscle of the shell; *br*, gills; *b*, mouth; *t*, tentacula, or prolonged lips; *f*, liver; *i*, intestine; *a*, anus; *co*, heart.

the *foot*, by which they can give motion to their bodies. But among the Mollusks inhabiting univalve shells, and others which are allied to them but possess no shell, we find the mouth situated on a projecting part, which also bears the various organs of special sense,—sight, smell, hearing, and taste, — more or less fully developed; and we find in some, that the powers of motion are greater, so that they are enabled to

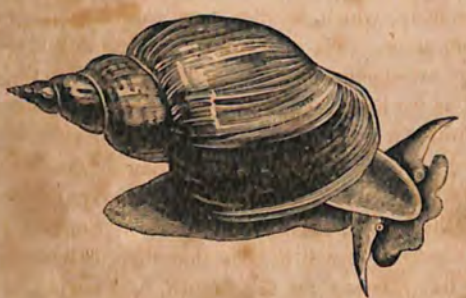

FIG. 31.—LYMNÆUS STAGNALIS, OR WATER-SNAIL.

go from place to place in search of food, instead of waiting for what is brought to them by the currents, which the action of their cilia creates in the surrounding water. Now, in these animals we always find the head possessing a symmetrical arrangement of its parts,—the eyes, tentacula (or feelers), &c., being arranged in pairs, on the two sides of the central line, as seen in Fig. 31. But the remainder of the body, which contains the organs of nutrition or vegetative life, is very commonly unsymmetrical externally, being disposed in a spiral which fills the interior of the shell, and having a complete want of uniformity in the arrangement of the organs themselves.

49. In the species which are destitute of shell, however, or which have but a small one that only partially covers the body, we find the symmetry more complete, and the powers of motion greater. This is the case, for example, with the group of *Pteropods*, of which an illustration is given in Fig. 32. Here we see that the two sides of the body are exactly alike externally; and the correspondence extends in great degree to the internal organs also. The movements of these animals through the water are comparatively active; and they remind us strongly of those of Insects or Birds, to which they may be considered as having a decided analogy (§ 4). Still, the general rule holds good, in regard to them also, that their muscular system is but little developed; the several bands and fibres of which it consists, having no firm points of attachment; and bearing no proportion, either in number, or in the variety of their actions, to those of even the lowest Articulata. This is the case also with the Cuttle-fish tribe, which presents many characters that lead us towards the Vertebrated series, and which depart widely from those of the typical Mollusks,—the essential peculiarity of whose organisation, is unquestionably the low development of the organs of *animal* life, in comparison with those of *nutritive* or *vegetative* life.

Fig. 32.—Hyalæa.

50. Thus we have seen, that there is a kind of antagonism between the characters of the Molluscous and of the Articulated series: for the former present the functions of nutrition in almost exclusive operation, their whole energy being (as it were) concentrated upon these, and their powers of sensation and locomotion being exercised almost exclusively for the acquirement of their supplies of food; whilst in the latter, the functions of animal life, sensation and spontaneous motion, are seen in the greatest activity, and the nutritive operations are carried on merely for the purpose of developing the mechanism in the first instance, and of subsequently keeping it in repair and supplying its waste. We observe a corresponding difference in the form of their bodies; for the symmetrical arrangement, which almost invariably presents itself in the organs of animal life, is so complete in the Articulata, as even to prevail in their organs of nutrition; whilst an absence of all symmetry shows itself in those Mollusks, whose bodies are made up almost exclusively of these last parts;—uniformity on the two sides being only visible in those, which have some capacity for movement; and merely affecting the head in those, whose motions do not exhibit more than the *sluggishness*, which is characteristic of the series taken as a whole.

51. Now, in the *Vertebrated* subdivision of the Animal kingdom, we find the characters of these two groups in some degree united. For there is in almost every member of it, a large share of the activity and acuteness of sensation, which is characteristic of the Articulated classes; whilst the nutritive apparatus is rather formed upon the plan of that of the Mollusca, and attains a still higher degree of development. In the *external* form of the body of the Vertebrata, we have, in almost every instance (a small group of Fishes constituting the only exception), a complete bi-lateral symmetry; and this symmetry extends to the internal parts, so far as the organs of animal life (the brain and nerves, the muscles concerned in the movement of the body, and the organs of sense), are concerned; but we do not find it so well marked in the organs of nutrition, which are, for the most part, unsymmetrical. Thus the heart of Man is not placed on the central line of the body, but on the left side; the

liver, chiefly on the right side; the stomach and pancreas on the left, — and other parts in the same irregular manner. The respiratory organs, however, always display more symmetry; probably, for this reason,—that they are more closely connected than any other of the organs of nutrition, with the apparatus of muscular motion, by which their actions are kept up. (ANIMAL PHYSIOL. Chap. VI.). But it is interesting to observe that, in Birds—the class of Vertebrata most distinguished for activity of motion—there is a more complete symmetry than is found among Mammals, thus affording another exemplification of the general rule just stated. The peculiarity in the construction of Vertebrated animals, however, has reference not so much to their external conformation, as to their possession of an internal skeleton; expressly adapted to give support and protection to the nervous system, which in this class attains its highest degree of development, and to afford fixed points of attachment to the muscles. In this respect, therefore, they are readily distinguishable from the Articulata, whose skeleton is external; and from the Mollusca, most of which have no skeleton at all. But as among the highest of this last group, there are some (of the Cuttle-fish tribe) which have the rudiments of an internal skeleton—so there are some among Fishes, in which the internal skeleton characteristic of the Vertebrated series is so little developed, that it has been doubted whether these animals deserve to be ranked in it at all. So that, well marked and decided as the line would seem to be, which separates the Vertebrata from Invertebrated animals, we may be obliged to hesitate through what exact points to draw it.

52. In the preceding sketch of the five great plans, on which the ever-varying forms of the Animal Kingdom appear to have been constructed, it has not been attempted to embody *all* the characters by which they are respectively distinguished; but to give to the young Naturalist such an *idea* of each, as may aid him in that first act of classification, which consists in ascertaining to which type a new or doubtful animal is to be referred. A more detailed account of each will be given at the commencement of that division of the work, which treats of the classes it

includes. But it will be advantageous here to show, how they may be distinguished by the examination of a single portion only of their structure; because we shall be thus led to see, how single and easily-recognised characters become of great importance in classification, provided they are found to be *constantly* associated with certain general types or plans of structure. A little consideration will show, that the Nervous System, being more or less concerned with all the functions of the body, but particularly with those of animal life, will probably exhibit, in the arrangements of its parts, very distinctive peculiarities in the four sub-kingdoms; and this is, in fact, the case.

53. In the *Protozoa*, as we have seen, no trace of a nervous system can be discovered. This is also the case with many of the *Radiata*, but in those members of this division in which it can be traced, it is arranged on the same plan with the other organs; its centres being disposed in a circle around the mouth, and connected by a cord that forms a complete ring, as shown in Fig. 33. Each of these

Fig. 33.—Nervous System of Star-Fish.

Fig. 34.—Nervous System of an Insect.

centres or ganglia supplies that part of the body, with which it is immediately connected; and seems to have precisely the same functions with the rest.—In the *Articulated* animals, we find a series of ganglia arranged along the central line of the body, and connected by a cord, which is always either evidently double (as in Fig. 34), or which may be easily separated into two equal tracts, one belonging to either side. And at the front extremity of this cord, situated in the head, there is a pair of ganglia larger than the rest, connected with the organs of special

sense, and evidently having a controlling power over the whole system.—In the *Molluscous* animal, again, as there is no repetition in the several parts of the body, so there is no repetition of ganglia, except on the two sides, when there are corresponding organs to be supplied. Thus we have usually a single or double ganglion in the head (where it exists), or in the neighbourhood of the mouth, connected with the organs of special sense; another for the actions of the respiratory apparatus, and another for the foot. Of these, the arrangement in the lower forms of Mollusca is represented in Fig. 35, and in the higher, in Fig. 36. There is a total absence of all regularity in the arrangement of the several ganglia; for their position varies continually in the different species, according to that of the organs they supply: thus, in the shell-less species, the place of the gills is continually varying; and that of the respiratory ganglion varies accordingly, being sometimes in the front of the body, and sometimes at its hinder-part, as in the Aplysia. Hence, if we were to find an animal having a series of nervous centres or ganglia scattered through the body—not forming a regular series arranged round the

FIG. 35.—NERVOUS SYSTEM OF PECTEN.

A A, cephalic ganglia; B, branchial ganglion; C, pedal ganglion; *e*, œsophagus.

FIG. 36.—NERVOUS SYSTEM OF APLYSIA.

A, cephalic ganglion; B, respiratory ganglion; C C, ganglia of the foot and mantle; D, pharyngeal ganglion.

mouth, as in the Radiata—nor disposed in a long row, as the Articulata—we should be right in ranking it as a Mollusk.—The Vertebrata have their principal nervous centres arranged in one continuous mass, which is enclosed within their bony skeleton: this mass consists of the Brain, which occupies the skull; and of the Spinal Cord, which is contained within the back-bone; and from it are supplied not only the organs of locomotion and sensation, but those concerned in the reception of food, and in the respiratory actions, which have distinct ganglia of their own in most Invertebrata.

Fig. 37.—Brain and Spinal Cord of Man.

54. A case in which the place of a doubtful group, the *Barnacle* tribe, might have been decided by the conformation of its nervous system, has been already adverted to (§ 32): here the division of the body into segments is very indistinct, and its external form has a general resemblance to that of the Mollusca; but the double nervous cord, studded with ganglia at intervals, which runs from one extremity to the other, shows its place to be among the Articulata,—a decision which has been confirmed by the discovery of its curious metamorphosis.

55. We have hitherto spoken chiefly of the principles, upon which a Natural System of Classification should be *constructed*; a few observations may be added, on the manner in which it may be advantageously *applied*. It has been shown that, in first arranging the different species into groups, and combining these groups into others, we must be guided by the *whole collection* of characters, which each animal presents. But if, whenever we meet with a form of animal life that is new to us, we were

obliged to examine its whole structure in order to discover its place in the scale, we should subject ourselves to a vast amount of labour, which must be a great impediment to the progress of Zoology. This, however, is by no means the case; for there are certain external characters, simple and easily recognised, which distinguish almost every class of animals from the rest; and which, consequently, enable us to refer an unknown species to the primary group to which it belongs, with very little difficulty. Thus, the Mammals are four-legged animals, whose bodies are more or less closely covered with hair. There is no other class, in which these two characters are united. All Reptiles, except Serpents, and a few Lizards, are four-legged; but their skins, instead of being beset with hair, are covered either with scales or with bony plates. And, again, some Insects and Spiders are hairy; but they have never so few as four legs. Hence, if we meet with a four-legged animal, with hairs even very thinly scattered over its body, we may be satisfied that it is a Mammal. Again, as there are no animals whatever, save Birds, that have their bodies covered with feathers, any creature on whose surface such a covering exists, must be unquestionably placed in that class. Further, in the Articulated Series, the higher classes may be recognised by the number of legs alone,—Insects having uniformly *six*, Spiders *eight*, and Crustacea not less than *ten*. Hence, if we found an animal having six legs, we should have no hesitation in stating it to belong to the class of Insects, even though it may be destitute of wings;* whilst any animal with eight legs would be placed among the Spider tribe, and any animal with ten would be assdciated with the Crabs and Lobsters. If the number were greater than ten, it would be necessary to examine the organs of respiration; for, if these were aquatic, the animal would belong to one of the lower groups of the class Crustacea; whilst if they were adapted to breathe air, it would be one of the Myriapoda, or Centipede tribe.

56. The same principle may be followed out in the subdivisions of the classes; so that, by a reference to the external characters alone of the animal examined, the Zoologist may be able to predict all the essential points of its internal structure. Now

* It is to be observed, however, that the young of many mites have only six legs.

some of these characters may be termed *natural*, because they have an obvious connection with the real or essential differences that distinguish the two groups; whilst others are considered as *artificial*, because, though extremely convenient to the Zoologist, they do not of themselves tell him anything respecting those differences. Thus, the popular error, formerly adverted to, of confounding Whales with Fishes, may be avoided by attending to either of two very easily-observed characters—the first *natural*, the second *artificial*. In the Whales, and other Mammals that inhabit the water, the tail is flattened *horizontally*, and its stroke is vertical, or up and down; but in Fishes, the tail is invariably flattened *vertically*, and its stroke is horizontal, or from side to side. This is a *natural* character, because it is closely connected with the mode in which one of those functions is performed, the plan of which is entirely different in the two groups: the Whales, which breathe air by lungs, require to come frequently to the surface in order to take it in; and the direction in which their tail strikes the water, enables them to rise or fall in it with great facility: but Fish, which breathe by means of the passage of water over their gills, do not require such a power, and the movement of their tail is chiefly destined to urge them rapidly through the water. Consequently, we could never expect to meet with a Whale having a tail vertically flattened, nor with a Fish having a horizontally expanded tail; and this character, therefore, would suffice to distinguish the animals of the two groups, without the aid of any other. But the inspection of a small part of its skin would of itself suffice to determine, whether a given animal were one of the Whale tribe, or a true Fish; for the skin of the Fish is covered with scales, whilst that of the Whales is destitute of any such protection, and has only a few hairs scattered over it. Now, this must be regarded as an *artificial* character; since we cannot discover what essential connection there is, between the internal conformation of the Fish and its covering of scales, or between the arrangement of the internal organs of the Whale, and the scanty covering of hair with which its skin is furnished. Moreover, although no Fish possess hairs, yet some Mammals are partially covered with a kind of scales; which shows that

there is no impossibility in the possession of a scaly skin by an air-breathing, warm-blooded animal; and we could not feel quite certain that a Whale-like animal might not be hereafter discovered, possessing a scaly skin—however improbable such a thing may be.

57. It should be the aim of the Zoologist, therefore, in the choice of the characters which he uses, for the most easy distinction of the animals composing the several natural groups,—into which, (it cannot be too often repeated), they must be associated by their *general* conformity of structure,—to select those which are the most *natural*, as indicating the nature of their internal structure, in preference to those which are *artificial*, giving no information beyond that derived from themselves. Hence, in classifying the Mammalia, the conformation of the teeth and extremities afford (in most orders at least) characters of the highest value; since these are intimately connected with the structure of the digestive apparatus, the nature of the food on which the animal lives, the mode in which it is obtained, and, consequently, the entire habits of the species. And, in the subdivision of the class of Birds, the conformation of the bill, wings, and claws, afford characters of similar value. In the arrangement of Insects, on the other hand, it is often necessary to adopt artificial characters for the separation of the several groups; because they are the only ones which are recognised with sufficient facility, and because our comparative ignorance of their internal anatomy, as well as of their economy, prevents us from understanding, as clearly as in the two classes just mentioned, how far differences apparently trifling in external conformation are essentially connected with those peculiarities, which really characterise the respective groups. Thus, the enormous order *Coleoptera* (Beetles) is subdivided into sections or sub-orders, according to the number of joints in the *tarsus*, or foot; a character which, at first sight, appears very trivial, but which really does bring together the families that have the greatest number of points of general agreement, and separates them from others which differ more widely from them. Hence it is probable, that an increased acquaintance with the habits and structure of these animals will show us, *why*

the presence of *five* joints in the tarsus should always accompany one set of internal characters; and why *four* joints should be found in the tarsus of those Beetles, which agree among themselves, and differ from the last, in certain other particulars. When that is the case, the character will deserve to be regarded as in *itself* a *natural* one; which it must already be considered in some degree, since the classification founded upon it alone has little of the artificial nature usually seen in arrangements formed upon single characters, and displaying itself so prominently in the Linnæan classification of Plants. (BOTANY, Chap. XIII.)

58. It is from this correspondence between single characters, and general plans of structure, that the Comparative Anatomist derives the power, already adverted to, of determining the nature of a whole animal from a single fragment of its skeleton, or from one of its teeth. In no animal is the body made up of a number of disconnected parts, united, as it were at hazard; for all its organs have a more or less intimate connection with each other; so that there is a kind of *harmony* amongst them all, and between every part and the entire structure. Thus, the simple inspection of the tooth represented in the accompanying figure, suffices to disclose to the scientific Naturalist the following facts regarding the animal to which it belonged. In the first place, there must have been a bony framework, in which this tooth was implanted, and which gave support to the rest of the body; and, as this internal framework does not exist in any other animals than those of the Vertebrated series, we know, by its possession of this tooth, that the animal in question had the brain and spinal cord, the complete set of organs of the senses, the red blood, &c. &c. which belong to that sub-kingdom only. Further, there are certain characters about the roots of this tooth, which enable the Anatomist to feel certain that it must have been implanted in a deep double socket, which is only the case in Mammals; so that he may further determine from them, that the animal belonged to this last class, and that it must have therefore possessed the organisation which is peculiar to it. Again,

FIG. 38.
CARNIVOROUS TOOTH OF A LION.

by the form of the crown of the tooth, it is easily shown that this tooth was destined to divide animal flesh; and that it consequently belonged to a Carnivorous quadruped. To digest this flesh, the animal must have had a stomach and intestinal canal formed upon a certain plan; and in order to obtain its prey, it must have had appropriate organs of locomotion and of prehension. Its extremities must have terminated in separate fingers, and these must have been armed with claws. The limbs must have been furnished with very powerful muscles, to enable the animal to give chase to its prey, or to spring upon it unawares; and afterwards to drag it to its den. The head, also, must have been connected with the spinal column by ligaments and muscles of great power, attached to elevated projections (spinous processes) of the vertebræ; in order that it may have the power of lifting the heavy bodies, which the animal desires to remove. The lower jaw must have been connected with the upper, by a hinge admitting but a scissars-like action, by which the edges of the cutting-teeth were constantly kept sharp; and the muzzle must not have been very protuberant, otherwise the strength of the muscles that raise the jaw would be applied at too great a disadvantage (ANIM. PHYSIOL. § 189). The cranial cavity must have been comparatively large, in order that the size of the brain might correspond with the degree of intellect which the habits of the animal required.

59. By inferences of this kind, and under the guidance of our knowledge of the forms at present existing, all the leading peculiarities of an animal may be deduced from any characteristic portion of it; for if any part, essential to the action of the remainder, had been deficient, the animal could not have maintained its existence. An animal with the carnivorous propensity of the Tiger, for example, and the teeth or hoofs of a Horse, could not remain alive, for want of power to obtain and prepare its nutriment; neither could a Horse exist with the long canine teeth of the Tiger, which would prevent the grinding motion of the jaws, required for the trituration of his food. The great principle is, therefore, that every animal is a combination of mutually-adapted parts, forming an harmonious whole; and that no one of these can be altered, without affecting all the rest, more or less considerably.

CHAPTER II.

GENERAL CHARACTERS OF VERTEBRATED ANIMALS.

60. The *Vertebrated* sub-kingdom, including the classes of Mammals, Birds, Reptiles, Batrachians, and Fishes, is characterised by the presence, in all its members, of an *internal* skeleton, composed of bone or cartilage, and forming an envelope to the nervous centres. In the Articulated classes, there is no vestige of any such structure; and the only Mollusca (some of the Cuttle-fish tribe) in which there is the least approach to it, are sufficiently distinguished by other characters. It is true that, among many of the Radiata,—such as a few of the Jelly-fish tribe, and a large proportion of the Polypes,—there is an internal skeleton, sometimes composed of a horny or cartilaginous tissue, and sometimes possessing even a stony hardness; but this gives equal support to the whole fabric, and is not arranged in such a manner as to give the least degree of peculiar protection to the nervous centres; so that, although it may be fancifully regarded as a kind of sketch, or shadowing-forth, in this lowest group, of the plan of structure which is characteristic of the highest, it cannot be said to have any real correspondence with it.

61. The animals of the Vertebrated series are, of all sentient beings, those whose faculties are the most varied and the most perfect. The principle of the *division of labour* is carried out in them to its highest degree; every function to be performed having its own separate organ, whose operations are limited to it alone; consequently, the Vertebrata are, of all animals, those in which the distinct organs are the most numerous and the most complicated. We may encounter many, among the lower tribes, in which the number of parts is as great, or even greater; but,

where this is the case, most of these parts are but repetitions of one another. It is by the *variety* existing in the form and structure of their several organs, and in the perfection with which each is adapted to perform its allotted function, that the Vertebrata are chiefly characterised. It is manifest that the *structure* of such animals must be regarded as *more elaborate* than that of beings in which the number of dissimilar parts is small, and every one of them capable of discharging a variety of offices; and that their *functions* must be performed with *more energy and completeness*, when carried into effect by instruments peculiarly adapted to each, than when several are the result of the actions of one organ. Hence we are justified in ranking the Vertebrata as the *highest* group in the Animal scale, independently of its being the one which contains Man. But we are *not* justified in speaking of the animals composing it, as *more perfectly* constructed than any others; since, in the eye of the Creator, they must be all equally perfect. In every one, the adaptation between the actions of its several parts must be complete; or it could not maintain its existence. And it should not be less wonderful to us, to meet in the Zoophyte with a simple structure, capable of performing all the functions of absorption, assimilation, respiration, and secretion; than to contemplate the numerous and elaborately-constructed organs, by which these several operations are respectively performed in the Vertebrated animal.

62. The development of all the organs in the Vertebrata seems to be subservient to that of the Nervous System;—*their* object being to give to *it* the means of the exercise of its powers. In almost every animal of the group, we find that the brain and spinal cord bear a much larger proportion to the entire bulk of the body, than do the nervous centres of any Invertebrated animal; and in Man, this proportion is greatly increased. It is not only in the actual bulk of the organs, that we see the importance here given to the nervous system; for this is still more shown by the quantity of blood which is transmitted to them. Thus it is calculated that the brain of Man receives about a fifth or sixth part of the whole blood in circulation, although its weight is not more than a fortieth or fiftieth part of that of the entire body: and

of the remaining blood, by far the largest portion is transmitted to the muscular system, which is the instrument of the nervous apparatus, in producing the movements of the various parts of the body. To prepare this blood, and to keep it in a state fit for the due performance of its functions, a complex digestive, respiratory, and secreting apparatus is requisite; but this vegetative part of the fabric does not live for itself alone, as it seems to do in Plants, and (almost to the same extent) in Zoophytes, and the inferior Mollusks; for it is entirely subservient to the maintenance of the functions of animal life, by keeping the nervous and muscular systems (together with the bony frame-work, and other parts connected with the movement of the body) in a state of good repair.

Fig. 40.—Brain and Spinal Cord of Man; *a*, cerebrum; *b*, anterior lobe; *c*, middle lobe; *d*, posterior lobe; *e*, cerebellum; *f*, medulla oblongata; *gg*, spinal cord.

63. The nervous system of Vertebrata cannot, as a whole, be properly compared with that of Invertebrate animals, unless we look at its lowest forms. In Man, we find

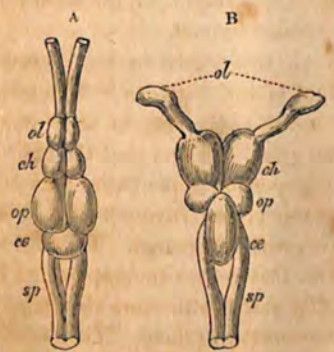

Fig 41. Brains of Fishes. A, Cod; B, Shark.

that the largest of its masses,—the brain proper, consisting of the cerebral hemispheres, and the cerebellum,—acquires such a size and relative importance, as to throw the others into the shade. It is therefore necessary to select for comparison, the nervous system of the lowest Fishes; and here we find a very remarkable correspondence. For the cerebral hemispheres (*ch*, Fig. 41), and cerebellum (*ce*), are here in a comparatively undeveloped state; and of the nervous masses contained in the head, the optic and olfactive ganglia (*ol* and *op*)—which are analogous to the *cephalic* ganglia of Insects and Mollusca (Figs. 34 and 36),—are seen to form at least as considerable a part. The spinal cord of Vertebrata is evidently analogous to the chain of ganglia in the bodies of the Articulata; so that between the lowest type of the nervous system in the former, and its regular plan in the latter, there is little essential difference. But as we ascend the Vertebrate series, towards Man, we find the cerebrum becoming larger and larger; until it acquires a size and importance, which for a long time induced the belief among Physiologists, that it is the essential portion of the nervous system,—the only centre of nervous power. This has been fully proved, however, not to be the case (ANIM. PHYSIOL., Chap. X.); a very large class of actions, including all those immediately concerned in the maintenance of life, being still performed when the cerebral hemispheres have been removed.

64. Upon comparing the relative development of this organ, in different Vertebrated animals, with the mental faculties whose possession they respectively manifest, it is difficult to avoid the conclusion, that the Cerebrum is the instrument of *Intelligence;* whilst the other portions of the nervous centres minister to *Instinctive* actions. It has been pointed out (ANIM. PHYSIOL. § 72) that the high development of the *instincts* is the prominent character of the Articulata; and that what we regard as the highest perfection of their structure, tends in this direction. On the other hand, there is a tendency among the Vertebrata to the removal of the animal from the dominion of undiscerning uncontrollable instinct, and to place all its operations under the dominion of an *intelligent Will.* We no longer witness in these

operations that *uniformity*, which is so remarkable a characteristic of those which are under the guidance of pure Instinct (ANIM. PHYSIOL., Chap. XIV.) There is evidently, among the higher Vertebrata especially, a power of choice and of determination, guided by a perception of the nature of the object to be attained, and of the means to be employed,—constituting the simplest form of the reasoning faculty. In Man, the reasoning faculties seem to attain the highest perfection that is compatible with their connection with a material fabric; the instinctive propensities are placed under their subjection; and all his acts, except those immediately required for the maintenance of his organic functions, are brought under their controul. But among the lowest of the Vertebrated series, the operations of instinct seem to be as predominant as in the Invertebrated classes; although, as they are inhabitants of the water, we are much less acquainted with them.—Hence we seem justified in asserting that the *Cerebrum* is the instrument of *intelligence*; and that the high development of it is the chief characteristic of the Vertebrated sub-kingdom.

65. It is more satisfactory, however, to define this group by the presence or absence of that internal skeleton, which is especially adapted for the protection of the nervous centres;—namely, the *vertebral column*. This essentially consists of a series of bones, termed *vertebræ*; through a perforation in the centre of which, the spinal cord passes. When these bones are fitted together, they form a continuous tube, in which this important organ is lodged; and they are connected together, in the living state, by ligaments and muscles, attached to the bony prominences or *processes* with which they are furnished. In this manner, the vertebral column possesses considerable flexibility; so that it may be bent into a curve, without injury to the organ which it protects. If it had been inflexible, the animal could not have propelled itself by any movements of its body, but must have been entirely dependent upon its limbs; and if it had been composed of but a small number of bones, the spinal cord would have been liable to

FIG. 49.—SINGLE VERTEBRA.

severe injury, from the sudden bends which its bony casing would have been forced to make.

Fig. 43.—Vertebral Column.

66. The flexibility of the spinal column varies much in degree, however, in different species of Vertebrata. In Fishes it is very great; the body being chiefly propelled by the strokes of its hinder part and tail from side to side, and the side-fins having but little else to do than to direct its movement. In Serpents, we find an entire absence of members or extremities, and the whole of the movement of the trunk is effected by itself alone; consequently the spine requires great flexibility. In these two groups we find an especial provision for this object; for in Serpents, the bodies of the vertebræ are not flat, but are convex on one side and concave on the other, so as to form a series of ball-and-socket joints, admirably adapted to give the greatest flexibility; and in Fishes, both surfaces of each vertebra are concave, and work upon a nearly globular bag of fluid, which is interposed between them. Such an arrangement as this last weakens the spine to a degree, which would prevent its being ever employed in a land animal, in which the weight of the body is thrown upon only four points, and in which there must be a certain resistance in the connecting framework: but in Fishes, in which every part of the body is equally buoyed up by the surrounding element, there is no necessity for such power of resistance, and flexibility is the great object to be attained. In some of the lowest Fishes, such as the *Lamprey* (Fig. 44), there is no proper vertebral column; the

Fig. 44.—Lamprey

spinal cord being inclosed in a flexible cartilaginous tube, the division of which into segments is only marked by some cross wrinkles: and in one species, even this is wanting, the spinal cord being only surrounded by a membranous envelope. Such

animals might be thought to be scarcely entitled to a place in the Vertebrated series; but they agree with Vertebrata in other points of their conformation; and the disappearance of even this most distinctive character of the group, in its lowest forms, is exactly what we should anticipate, on the principles formerly stated (§ 35).

67. The vertebral column terminates at its upper or anterior extremity, in the *cranium* or skull; which is a large bony casing, formed of several pieces, closely united together, and adapted to protect the brain, which it completely incloses, as well as to afford a secure lodgment for the organs of special sense,—the eyes, nose, tongue, and ears. These organs, with very few exceptions (and these principally relating to the eyes), are *all* present in every Vertebrated animal; which is not the case in regard to the greater portion of the Invertebrata.—At the opposite end, the vertebral column is usually contracted into a tail; which is composed, like the part that gives support to the trunk, of vertebræ jointed together; but less complicated in their structure. The tail is developed in various degrees in different animals;—*least* in Man, and in the Apes which approach nearest to him, although even they have a rudiment of it;—and *most* in Serpents and Fishes, in which the tail is the continuation of the body. It has to serve a great variety of purposes; and is often an organ of the greatest importance in locomotion.—A curious *antagonism* may often be observed, between the development of the cranium, and that of the tail. When the head is large (as in Man), the tail is most commonly short and insignificant; and when the tail is very large, the skull is usually small; but this does not invariably hold good.

68. With the vertebral column are connected the *ribs*, which are rarely absent; and also the bones of the extremities or *members*, which are also occasionally wanting, and which are developed in very varying degrees in different species. They are altogether absent in the Serpent tribe, and also in a considerable group of Fishes. In the Whale tribe, the posterior extremities are absent; and the anterior members, forming the paddles or flappers, are small in comparison with the bulk of the body.

The extremities attain their greatest development in Birds and terrestrial Mammals; whose motion is almost entirely due to them. In these cases, the spinal column requires more firmness; in order that a sufficient support may be given to the limbs, and that the muscles that move them may have fixed points from which to act. Hence the vertebræ are often found to be securely locked together by processes, or projections of bone, which fit into each other, and render displacement difficult, even when the ligaments have been removed. This is most the case in Birds, in which class the whole bony framework of the trunk is so constructed, as to be very little capable of movement; the powers of motion being delegated, as it were, to the limbs, which can act more advantageously in proportion to the fixity of the points from which their muscles act. They stand in remarkable contrast, therefore, to the groups of Fishes and Serpents, just now adverted to; in which, from the absence or low development of the extremities, the movements are performed altogether by the trunk, and the vertebral column is proportionally flexible.—In no instance is the number of members greater than four.

69. The Vertebrata are distinguished from Invertebrated animals, by the possession of *red* corpuscles (commonly termed globules) in their blood; and a marked difference hence exists between their circulating fluid and that of the lower tribes, which is colourless or nearly so, containing only the white or colourless corpuscles, (ANIM. PHYSIOL. § 235). They have, moreover, a separate system of vessels for the absorption of nutrient fluid, both from the alimentary canal, and from the substance of the body itself; to which we find nothing analogous in the Invertebrata. These vessels are termed *absorbents* (ANIM. PHYSIOL. § 217); and they empty the fluid which they have taken up, and which bears a strong analogy to the blood of the Invertebrated animals, into the current of the circulating blood. This current is regularly kept up, in Vertebrata, by the action of a heart, endowed with considerable muscular power; and the blood is sent, by its means, not only to the body in general, but also to the respiratory organs, in which it is to be exposed to the influence of the air. These organs are always restricted to some particular portion of

the body, not being in any instance diffused or scattered throughout the whole, as in Insects and some other tribes. In all but the lowest group, namely, Fishes, and the Batrachians (Frogs, Newts, &c.) during their larva state, the organs of respiration are adapted to breathe air; but in those, the aquatic respiration, characteristic of the Molluscous classes, is still retained. In the classes in which the respiration is carried on most actively, and in which the *whole* mass of the blood is exposed to its influence, before again circulating through the system,—namely, Mammals and Birds,—the animal has the power of maintaining an elevated temperature, independent of that of the surrounding air; and they are termed *warm-blooded* from this circumstance; those in which the temperature of the body varies with that of the surrounding air or water, being *cold-blooded*. There is a further essential distinction among the different classes of Vertebrata, dependent on the mode in which the function of reproduction is performed in them; this takes place by eggs in the four lowest classes; but in the highest, that of Mammals, the young are born alive, and are nourished afterwards by suckling.

70. It is upon the mode in which the functions of Circulation, Respiration, and Reproduction, are performed, in the different groups of Vertebrata, that their division into *classes* is founded; and the following table will show the principles on which this is accomplished; besides furnishing some other characters, which have not been here adverted to, but which will be hereafter considered in detail, under their respective heads:—

	Mammals.	Birds.	Reptiles.	Batrachia.	Fishes.
Reproduction	Viviparous,	Oviparous,	Oviparous,	Oviparous,	Oviparous.
Respiration	Aerial,	Aerial,	Aerial,	Aquatic and aerial,	Aquatic.
Heart	Four cavities,	Four cavities,	Three cavities,	Three cavities,	Two cavities.
Circulation	Complete double,	Complete double,	Incomplete double,	Incomplete double,	Complete single.
Temperature	Warm,	Warm,	Cold,	Cold,	Cold.
Blood discs	Circular,*	Oval,	Oval,	Oval,	Oval.
Covering	Hair,	Feathers,	Scales,	Scales or none,	Scales.
Members, adapted for	Movement on the ground,	Flight,	Movement on the ground,	Walking or Swimming,	Swimming.

* Oval in a few exceptions.

CHAPTER III.

OF THE CLASS MAMMALIA.

71. The class Mammalia is composed of Man, and of all the animals which resemble him in the most important points of their organisation. It is naturally placed at the head of the Animal Kingdom, because composed of the beings, whose movements are the most varied, whose sensations are the most delicate, whose faculties are the most numerous, and whose intelligence is the most developed; and it interests us more than any other, as it furnishes us with the animals which are most useful, whether as serving for our nourishment and for labour, or as supplying the materials of our manufactures.

72. It is in general easy to distinguish a Mammal, at the first glance, from a Bird, a Reptile, a Fish, or any other animal; by the single observation of its external form, and the nature of its covering: for the Mammalia are the only vertebrated animals whose bodies are covered with hair; and their general form usually differs but little from that of the species which we have continually before us, and which we naturally take as the types

Fig. 45.—Porpoise.

of this group. But they are not always recognisable by so slight an examination; for there are some whose skin is completely

bare, and whose body, instead of resembling that of a Dog, a Horse, or any ordinary Mammal, presents the form belonging to Fishes. Such are the *Porpoise* (Fig. 45), the *Whale*, and other Mammals of the order Cetacea, which are commonly, but erroneously, reckoned as Fishes. (§ 25.)

73. *Development and Lactation.*—That which is most distinctive of the Mammalia, is their mode of development and of nourishment during the earliest period of life. These animals are all born alive; and in their previous embryonic condition, their life is not supported by a separate store of nutritive matter, as is the case amongst oviparous animals, but they derive their nourishment direct from the blood of the mother; and, after birth, the young still live at her expense, as she suckles them for a longer or shorter time. The *milk*, destined for this purpose, is a white and opaque liquid, composed of water, holding in solution sugar, casein (which forms the curd), with certain salts; and holding in suspension some globules of butter. Its qualities vary a little amongst different animals, and may be modified by the food of which they make use. In general it leaves, by evaporation, from ten to twelve per cent. of solid parts; but its richness may vary much according to circumstances. This nutritious liquid is secreted by particular glands, named *mammary*, which exist in both sexes, but which in the females alone serve for the support of the young. Analogous organs are not to be met with in any other class of the Animal Kingdom; and it is from their existence amongst all the animals composing the group whose history we are commencing, that Zoologists have given to these beings the name of MAMMALIA. The number of the *mammary glands* is in general nearly in proportion to that of the young produced at each birth. There are often only two (amongst the Monkeys, the Elephant, the Goat, and the Horse, for example); but sometimes, also, their number is much more considerable. Thus, the Cow, the Stag, the Lion, have four; the Cat, eight; the Pig and the Rabbit, ten; the Rat, ten or twelve; and the Agouti, twelve or fourteen. The position of these glands varies also. Amongst the Monkeys and Bats they are placed upon the thorax, as in man; in the greater number of Carni-

vorous animals, they are situated on the abdomen as well as the thorax; and in the Horse, Cow, and Sheep, &c., they are placed still farther back, near the hip-joint.

74. Sometimes the young are born with their eyes open, and can immediately run about, and procure their own food; but a great number of the Mammalia come into the world with their eyes shut, and in a state of such weakness that they can scarcely move. There are even some, that appear as if born prematurely; for their body is hardly formed, and they could not live if they did not become grafted, as it were, on the breast of their mother, where they remain suspended for a considerable time. It is also to be remarked, amongst the greater part of the animals which are born in this extreme state of imperfection, that the skin of the abdomen, in front of the mammary glands, forms a pouch,

Fig. 46.—Opossum.

which contains and protects the young. This peculiarity of structure characterises the Opossums (Fig. 46), the Kangaroos,

and the other Mammalia of the order Marsupialia;—animals which principally inhabit New Holland. The young complete their development in the interior of this pouch, each suspended by a teat, which penetrates deeply into its mouth, and from which the milk is conveyed into the throat, by the contraction of the muscles of the mammary glands. When arrived at a certain age, they detach themselves: but they still continue to derive support from their mother; and even for a long period after having left the pouch which has until then been their home, they seek it as a refuge against cold or the dangers by which they are threatened.

75. *Integuments.*—The skin, as we have already stated, presents amongst the Mammalia many remarkable peculiarities. In a small number of these animals it is bare; but in the principal part it is covered with *hairs*, which serve to protect it, and to preserve the heat developed within the body. The existence of these appendages of the skin is so characteristic of this class, that one of the best modern Zoologists, M. de Blainville, has proposed to replace the name of Mammalia by that of *Pilifers* (hair-bearing); which would contrast with the word *Pennifers* (feather-bearing) and *Squamifers* (scale-bearing) which he would wish to be adopted to designate Birds and Fishes. The hairs are produced by small secreting organs in the thickness of the true skin, or immediately under it. Each hair is formed in a small egg-shaped bag, with white and resisting walls; which opens at the surface by a narrow orifice, and which is called the capsule. The interior of this cavity is lined by a membrane, sometimes reddish, sometimes differently coloured, which appears to be a continuation of the outer layer of the skin; and at its lower part is found a conical papilla or bulb, which receives a nerve and blood-vessels, and which produces the hair. The substance of which these appendages are principally composed, is more analogous to *horn* than any other. In examining them with a microscope, we can generally distinguish a sheath of horny consistence, like that which forms the barrel of a quill, enveloping a softer medullary or pith-like substance, the tubular character commonly attributed to them being an optical illusion. Amongst the greatest number of Mammals the hairs are cylindrical, or rather larger at

the bottom than at the top; they are frequently more or less flattened, and some are completely *laminated*, or pressed into plates, like blades of grass. Sometimes their surface appears to be perfectly smooth, and at other times it is fluted, or furnished with little elevations, or else presents a bead-like appearance. In short, their size, their shape, and their elasticity, vary greatly among different animals, and even in different parts of the body of the same individual.

76. The name by which we distinguish the numerous varieties of hair, differs according to the properties of these horny filaments, and according to the parts on which they grow. Thus they are termed *prickles* when they are very large, pointed, and stiff, resembling spines (in the Porcupine and the Hedgehog for instance); and *bristles* when they are smaller and less resisting, but still very stiff, except towards their extremity, as in the Hog.

FIG. 47.—PORCUPINE.

Horse-hair only differs from Bristles, in being a little more supple, and of smaller size; in general it is, like them, quite straight; sometimes, however, especially when very long, it is

slightly curled. *Wool* is a kind of *long hair*, very fine, and twisted in every direction; and lastly, *Down* is composed of hairs of extreme fineness and softness, and is principally found hidden under a more or less dense covering of common hair.

77. The colour of hair varies much, but is almost always some modification of white, black, brownish-red, or yellow; it appears to depend on the existence of a coloured fatty matter, which is soluble in boiling alcohol. When this oil is extracted by the action of the liquid just mentioned, the hair always becomes of a grayish yellow. In white hair we also find a white oil, which in red hair is replaced by a reddish oil; and in black hair, the existence of an oil, tinged of a blackish-blue by sulphuret of iron, has been observed. Sometimes the hairs preserve the same colour through their entire length; sometimes their hue is deeper at the point than at the base; and sometimes, also, they present a series of white and coloured rings. Moreover, their colour varies nearly always in different parts of the body; and the general arrangement of these tints is characteristic of particular species of Mammals. These colours are generally much deeper on the upper than on the under surface of the body; and when they form spots, these are nearly always disposed symmetrically on each side;—provided, at least, that the animals have not been domesticated, for then their markings often present very great irregularity. The colour and marking are usually the same in both sexes, and in general vary but little at different ages. In some species, however, the young have spots, and a variety of shades, which disappear in the adult; and it frequently happens that the colour of the Mammalia changes with the seasons.

78. The hairs generally fall off at a certain period of the year, and are replaced by others; this moulting chiefly takes place in Spring and Autumn. Sometimes this is effected without the colour being altered; at other times it causes very considerable changes both in the colour, the quantity, and the nature of the hair. Thus our common Squirrel (Fig. 48), whose hair is deep-red in summer, becomes a beautiful blue-grey in winter. In this latter season, the fur of the Mammalia is generally much

thicker than in summer; and under the softer hairs we find a greater or less quantity of down, which forms a part of it. The influence of temperature is perceived in the same manner, in the covering of animals inhabiting different climates; for those of cold countries have a thick fur, abundantly furnished with down; whilst those of warmer climates have nothing but a few short, dry hairs. That which particularly distinguishes *Furs*, is the fineness, softness, brightness, and abundance of the hair; and after what has been said with regard to the influence of the seasons and climate upon the covering of the Mammalia, we may anticipate that it is in the coldest countries, on the mountains, and particularly during the winter, that the most beautiful fur-skins are found; and, in fact, it is from the North, that the greatest part of these are brought. Russia, and other European countries, furnish some furs; but it is chiefly in Siberia, and the northern part of America, that the trade in Furs becomes really important.

FIG. 48.—SQUIRREL.

79. When the bulbs of the hair are set very close, the horny

FIG. 49.—PANGOLIN.

filaments which they produce unite themselves (as it were,

together, and form solid plates; it is in this way that the scales are produced, which cover the body of some very remarkable Mammalia, known under the name of *Pangolins* (Fig. 49), and the cuirass of the *Armadillos* (Fig. 50). Anatomists agree also in regarding the nails and the horns of other Mammals, as having a similar origin.

Fig. 50.—Armadillo.

80. *Skeleton.*—The general form of the body is principally governed by that of the Skeleton; sometimes, however, it pre-

Fig. 51.—Skeleton of the Camel.—*vc*, cervical vertebræ; *vd*, dorsal vertebræ; *vl*, lumbar vertebræ; *vs*, sacral vertebræ; *vq*, caudal vertebræ; *c*, ribs; *o*, scapula; *h*, humerus; *cu*, bone of fore-arm; *ca*, carpus; *mc*, metacarpus; *ph*, phalanges; *fe*, femur; *ro*, patella; *ti*, tibia; *ta*, tarsus; *mt*, metatarsus.

sents peculiarities which do not correspond with the arrangement of the internal frame-work; thus the hump on the back of the *Camel* is not supported by bone, and only consists of a mass

of fatty tissue.—The Skeleton of Mammals always shows in its conformation a great analogy with that of Man (Anim. Physiol. § 616—649). The differences which are remarked amongst the various animals of this class, depend essentially;—First, on the absence of abdominal members in the fish-like Mammalia, such as the Porpoise, and the Whale, which Zoologists have included in the order Cetacea;—Secondly, in the diminution of the number of fingers, and in the absence of the Clavicle, amongst the greater number of those species whose members serve only for walking;—Thirdly, in variations in the number of Vertebræ, especially in the dorsal and caudal regions;—Fourthly, in the inequalities in the relative sizes of the same bones.

81. *Conformation of the head.* The shape of the bony part of the head varies much, according as the face is more or less extended, or the brain-case developed in a greater degree; and the study of these differences in proportion is not without interest, since, as we have already seen, there exists in general a very direct connection between the degree of intelligence with which an animal is endowed, and the relative size of that portion of its skull which contains the brain. The further we remove from Man, we see the cranium diminish, the jaws and the nasal cavities become more extended; the orbits are directed more and more outwards, and become less and less distinct from the temporal fossæ; and finally the occipital foramen, (the aperture which gives a passage to the spinal marrow,) and the two condyles by which the head is connected with the vertebral column, instead of being placed towards the middle of the inferior surface of the cranium, are carried further and further back, and end by occupying the posterior aspect of it. So that the jaws,

Fig. 52.—Skull of Horse; *oc*, occipital bone; *t*, temporal; *f*, frontal; *n*, nasal; *m*, superior maxillary; *im*, intermaxillary; *mi*, inferior maxillary; *o*, orbit; *i*, incisor teeth; *c*, canines; *mo*, molars.

instead of forming a right angle with the vertebral column, become parallel with the axis of the body. The mode in which the lower jaw is articulated with the cranium, is characteristic of the Mammalia; this bone is directly connected with the skull, by two projecting condyles; and the portion of the temporal bone which receives it, is united with that which forms part of the walls of the skull; whilst amongst Birds, Reptiles, and Fishes, the jaw is suspended by an intermediate bone, interposed between it and the main portion of the temporal.

82. Some of the Mammalia have a remarkable peculiarity in the conformation of their head,—the existence of horns of various lengths. Sometimes these prolongations are only appendages of the skin, and appear to be formed of hairs united together; this is the case with the tusk with which the nose of the Rhinoceros is armed. In general, however, it is otherwise; the axis, or centre of these appendages being formed by a prolongation of the frontal bone. The Mammalia which are furnished with bony, branching horns, all belong to the order of the Ruminants; and exhibit very considerable differences in the structure of these organs. The bony protuberance is sometimes covered by the skin of the forehead, which does not differ at this part from that of the rest of the body, and which does not change; this is the case with the *Giraffe*. In other cases, the bony portion of these horns is [illegible]red with a hairy

Fig. 53.—Rhinoceros.

Fig. 54.—Stag.

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skin, which wears away; and after it has remained bare for a certain time, it falls off and gives place to a new horn, which is destined to experience the same changes in its turn. These perishable horns are called *antlers;* and they are only found amongst animals of the *Stag* tribe. In other instances, again, the bony axis grows during the whole of life, never falls off, and is covered with a kind of sheath composed of an elastic substance, named *horn*, which is analogous to that of the nails, and which increases by successive layers. The name of *hollow horns* is given to these appendages, when thus inclosed in a case which seems formed of united hairs; and we find them amongst the different kinds of Oxen, Sheep, Goats, and Antelopes. It is further to be noticed, that in all these animals, with the exception of the Antelope, the bony core of the horns is hollowed out into large cells, which communicate with the frontal sinus of the nose, and thus receive air into their interior.

FIG. 55.—HEAD OF A GOAT.

83. The mode of formation and renewal of the kind of horn known under the name of *antler*, is very simple, and is worthy of notice in this place. At a certain age, there is developed on each side of the frontal bone, a projection, whose formation may be compared to that of the tumours known in medicine under the name of *exostoses*, or to that of the *callus*, which is deposited around the extremities of the ordinary bones in cases of fracture, and which serves to reunite them. These protuberances, whose tissue is very compact, grow rapidly, and raise up the skin which covers them. They receive a great quantity of blood from numerous vessels which run along the surface, and also from those which traverse canals excavated in the interior; and the formation of new bony substance goes on for a time with great energy. But this very energy soon checks itself; for as new bony matter is deposited in the channels containing blood-vessels, these channels are obstructed, so that the supply of blood is progressively diminished, and at last ceases altogether. The

bone of the antlers then experiences the fate of all bones deprived of their nutrient fluid; that which takes place as a result of injury in the human body, here occurring in consequence of the natural changes which have been just related. The bone is affected with the disease termed *Necrosis*, dies, and finally detaches itself from the head, and falls off. The animal then remains unarmed; but after a short time (generally 24 hours), a thin pellicle covers the wound created by the fall of the horn, and a fresh bony prominence soon rises up in the place of the old one. In general the new horn acquires much greater size than that which it succeeded. The number of its branches is also usually much more considerable; but it does not last longer, and it passes through the same changes as the first. It is generally in spring that these curious phenomena take place; and the renewal of these horns occurs nearly every year. The male alone usually has the head adorned in this manner. One remarkable species, the Reindeer, forms, however, an exception to this rule; the female having horns as well as the male.

Fig. 56.—Trunk of an Asiatic Elephant.

84. A curious anomaly, which is met with in the conformation of the head in certain Mammalia, depends on an excessive development of the nose, which is prolonged so as to form a movable and prehensile trunk. Such is, in fact, the nature of the organ which gives so peculiar an appearance to the Elephant, and to which it owes its great address. The trunk of these animals is a double tube, which is continuous above with the cavity of the nose, and which is lined internally with a fibro-tendinous membrane; around this are fixed some thousands of small muscles, variously twisted and arranged, so as to lengthen it, to shorten it, and to bend it in all directions.

At its upper extremity there exists a cartilaginous and elastic valve, which, except when raised by the voluntary contraction of its muscles, intercepts the communication between its passages and the nasal cavity; and at its free extremity is found an appendage, shaped like a finger, and equally movable. This long trunk serves the animal to seize whatever it wishes to carry to its mouth, to take up the grass and the leaves with which it supports itself, and to suck up the water, which it then ejects into its throat: without it, the general conformation of its body would render its continued existence impossible; for in order that an animal may conveniently obtain its nourishment from the ground, it is requisite, if it is not provided with special organs of prehension, that the length of its neck should be proportional to that of its legs; so that, by its aid, it may be able, without bending them, to touch the ground with its lips. If it is high on its feet, it must, therefore, have a long neck; and this, in its turn, would be incompatible with a very large, heavy head, the weight of which would become still more difficult to support, if it were placed at the end of a still longer neck. Hence we observe, that amongst all the animals whose legs are long, and whose mouth serves for the prehension of their food (the Giraffe, for example), the neck is long, and the head small; whilst among those whose head is strong and heavy, or destined to execute very energetic movements, the neck is more or less short. Now, the Elephant is a very large animal, whose head is very far removed from the ground, and of a size in proportion with the enormous defences with which the upper jaw is armed; its weight is consequently very considerable, and the neck which supports it very short. If it were deprived of its trunk, it would, therefore, be necessary to reconstruct the whole remainder of its organisation upon a different plan.

85. The Elephants, of which there are only two species at present existing,—the one belonging to Africa, and the other a native of India,—are the only Mammalia that are provided with such an organ of prehension; but there exists something analogous to it amongst certain animals of the same class, which are destined to seek their nourishment from the ground. Thus the *Tapirs*,

animals nearly allied to the Hog, have their nose much prolonged in front of the mouth, constituting a little trunk, capable of lengthening and shortening itself. The *Desmans*, small insectivorous animals, nearly allied to the Shrews, but formed to swim

Fig. 57.—Head of Tapir.

Fig. 58.—Desman.

with ease, and to live at the bottom of burrows hollowed in the banks of rivers, also exhibit a similar conformation.

86. The vertebral column in this class presents only slight modifications; and everywhere shows the same characteristics as in Man. We shall only remark, that its length varies much, and that the number of vertebræ of which it is composed is far from being uniform. These numerical differences principally depend on the unequal development of the *caudal* portion (or tail-end) of the column. Thus, the coccygeal vertebræ sometimes do not exist at all, (as amongst certain Bats, for example); in other instances, we reckon forty, fifty, and even more than sixty of them. It is also observed, that these coccygeal vertebræ are of two kinds; in the one kind a passage is retained for the spinal marrow, whilst

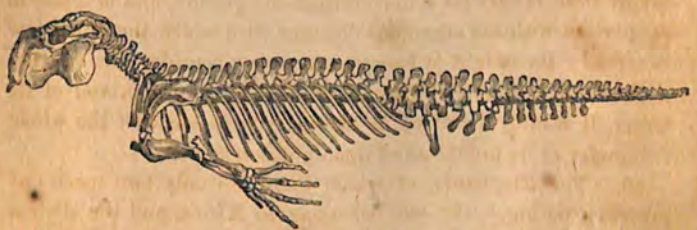

Fig. 59.—Skeleton of Dugong.

the others have none. Their *processes* are much larger when the tail is very strong and movable; but among the greater part of

the Mammalia this organ is of little use for locomotion, though amongst others it becomes a very powerful instrument for it. Thus, in the *Kangaroos*, the *Jerboas*, &c., the tail, with the hind feet, forms a kind of tripod, upon which the animal sits and makes its spring. Among a great number of the American Monkeys it is prehensile, and serves these animals as a fifth hand, to suspend themselves from the branches of trees; and, lastly, amongst the Cetacea, it grows to an enormous size, and becomes the principal instrument for swimming. Under the first caudal vertebræ of these last animals are certain bones in the shape of a V; which seem to represent the ribs; and which are of use in increasing the power of the muscles that bend this part of the body.—The length of the neck also varies very considerably. Amongst the Giraffes, for example, it is very considerable; whilst in the Whales it is extremely short, and yet the number of vertebræ, which are seven as in Man, is really the same. We only know one exception to this rule—the Lamantin, which has only six. The *Ai*, or Three-toed Sloth, constitutes an additional *apparent* exception; the number of its cervical vertebræ seeming to be *nine;*—but the two lowest of these are furnished with rudiments of ribs, as seen at 3, 4, in the accompanying figure, and are therefore really *dorsal*.

FIG. 60.—VERTEBRÆ OF AI.

The first and second are the lowest true cervical, the third and fourth the additional or false cervical, and the lower ones the dorsal.

87. The conformation of the thorax varies but little; the number of the ribs corresponds with that of the dorsal vertebræ, and is in general from twelve to fourteen pairs; sometimes, however, it increases still more. Thus, in the Horse, there are eighteen pairs, and in the Indian Elephant twenty pairs. The

Sternum is generally narrow and flat; but amongst the Bats, where the lower muscles of the wing are required to have great power, and must find a large surface for their insertion in this bone, it often presents an elevated crest on its central line, which somewhat resembles the keel of the breast-bone in Birds. In all the animals of this class, the thoracic cavity is separated from the abdomen, by a complete division formed by the diaphragm.

88. *Members.*—The members are four in number among all the ordinary Mammalia; but in the Whale, and other fish-like Mammalia usually known under the name of *Cetacea*, there are only two, the hinder extremities being absent. As in Man, these organs are always composed of a jointed lever, which is divided into three principal parts;—the arm or the thigh, the fore-arm or the leg, and the hand or foot; but the mode of conformation of these different parts varies a little, in accordance with the uses to which they are destined.

89. The frame-work to which the upper or thoracic extremity is attached, is principally composed of a large flat bone, which is supported on the ribs, and which gives an attachment to the humerus; this is called the *Scapula*, or blade-bone (*o*, Fig. 51). This bone is prolonged in a direction parallel to the vertebral column, in proportion to the violence of the efforts which the animal is destined to make with the member attached to it; and by this extension, it affords greater space for the attachment of the muscles, which draw the arm towards the body. In those Mammals which employ their upper extremities for prehension, or as organs of flight, and which require to draw them inwards forcibly towards the chest, we find that the scapula is kept in its proper position by means of the *clavicle*, which is united to it at one extremity, whilst by the other it bears against the sternum (Fig. 85); but in those species, in which movements of this kind are but little or not at all required, the clavicle is completely wanting, or only a rudiment of it is found. This is the case in all the hoofed Quadrupeds, as well as in many others. In certain of the very remarkable Mammalia of New Holland, such as the *Ornithorhynchus*, on the contrary, the bones of the shoulder

attain a very high degree of development; and their arrangement more resembles that which is found in Lizards and Birds, than that which prevails among ordinary Mammals. A bone in the form of a Y (*d*, Fig. 61) is applied on the upper or anterior extremity of the sternum, *s*, and sends its two branches to the two scapulæ, in the same manner as the *furcula* or merry-thought of Birds (ANIM. PHYSIOL. § 89); two pieces, *co*, situated beneath this fork-like pair of clavicles, represent the coracoid bone of Birds and Lizards, which in ordinary Mammals is but a small projection from the scapula, not nearly long enough to reach the sternum; and finally the scapula itself, *o*, instead of terminating in the cavity, *h*, which lodges the head of the humerus, is prolonged beyond it, and comes to meet the sternum, *s*;—thus having three bony connections, where in many Mammals there is none at all, and in no others more than one. The functions of the lower or hinder members vary less than those of the upper; hence the mode in which they are connected with the trunk is much more uniform, except amongst the *Cetacea*, in which they exist only in a rudimentary state. The bones of the hip are always immovably fixed to the sacrum, and are united together at their lower extremities, so as to form a complete ring more or less deep, termed the *pelvis* or bason. The form and size of this bony circle vary greatly; and it may be remarked that, when other things are equal, the vertical position—in which the

FIG. 61. STERNAL APPARATUS OF ORNITHORHYNCUS.

FIG 62.—PELVIS OF THE ECHIDNA; *c*. base of the vertebral column; *i*, iliac bone; *m*, marsupial bone; *f*, cavity for the head of the femur

trunk is raised upon the abdominal members, is much easier in proportion as the pelvis is larger. It is further to be mentioned that, amongst the Opossums and the other Marsupial Mammals, the muscles of the abdomen, forming the pouch of these animals, are supported by two bones which arise from the anterior part of the pelvis, and are known to Anatomists under the name of Marsupial bones. (Fig. 62.)

90. The arm and the thigh each present, among all the Mammalia, but one bone, the *humerus* and the *femur*. The

Fig. 63.—Bones of the Anterior Extremity of the Mole.

bones of the fore-arm and of the leg are generally the same as in Man; but amongst the Bats, there is a distinct bone resembling a knee-pan, in the elbow-joint, as well as in the posterior members. All these bones are generally shorter and larger, in proportion as the animal has occasion to move these limbs with greater force; and on the contrary, they are long and thin, when quickness is the essential character of the movement they are destined to execute. The *Mole*, which uses its anterior members to dig the ground (Fig. 63), and the Antelopes (Fig. 64) or the Musk-deer, which astonish us by the lightness and extent of their leaps, will serve as examples of these two kinds of modifications.

Fig. 64.—Bliss-bok Antelope.

91. When the hand becomes the organ for locomotion, and not for prehension, the

radius can no longer turn upon the *ulna*, and is so closely united to it that it can no longer be distinguished; this is also the case with the *fibula*, which is joined with the *tibia* among the hoofed quadrupeds. The conformation of the hand and foot varies greatly in this class of animals, according as these members are intended to serve for walking, for prehension, for swimming, or for flying. These curious modifications are elsewhere dwelt upon (ANIM. PHYSIOL. Chap. XII.), and consequently it is not necessary for us to describe them here; we shall only add that the number of fingers never exceeds five, and diminishes in proportion as the four members are devoted more exclusively to walking.

92. *Organs of Sensation.*—The degree of flexibility of the fingers, and the nature of their movements, influence their use, not only as organs of locomotion and of prehension, but also as instruments of the sense of feeling. When they cannot take hold of the objects to feel them, and when the hand cannot mould itself, as it were, upon their form, feeling becomes necessarily very imperfect; and that which tends to deaden it still more, is when the nail, instead of leaving the end of the finger in great part uncovered, completely envelopes it, and takes the form of a hoof. Now the greater or less perfection of this sense influences, in its turn, the development of the intellect; and it may be said with truth, that in the immense majority of cases, if not in every instance, the faculties of Mammalia are elevated in proportion as their members are better formed to seize and to feel.

93. The organs of the other senses, in all the animals of this class, present nearly the same mode of organisation as in Man. In those which are remarkable for the delicacy of their smell (as is the case among the Carnivora more than any others—the Dog, for example), the nasal bones and the frontal sinuses are increased very considerably, and the spongy bones, which project within the olfactory cavity, are much more developed. (ANIM. PHYSIOL. § 506). It is easy to perceive the usefulness of these differences, as they tend to give to the lining membrane, which is the seat of this sense, a more extended surface.

94. The Eyes are in general proportionally larger among the

nocturnal Mammalia, than in those which seek their food by day; and, among the former, the pupil, when contracting under the influence of light, instead of preserving its rounded form, usually becomes a narrow slit. Amongst those which are condemned, by their subterranean life, to complete darkness, (as the Moles, for example), the eyes become extremely small, and sometimes only exist in a rudimentary state; and in those Mammalia which live in the water, the crystalline lens is more spherical than among those that live in the air. This arrangement is necessary, in order to increase the refractive power of the eye; which, every thing else being equal, requires the power of refracting the rays of light with greater power, in proportion to the density of the medium in which it is placed. It is remarked, also, that among many of these animals there is, on the choroid at the bottom of the eye, a brilliantly-coloured spot, which is called the *tapetum*; but of its use we are ignorant. There are several, also, which have a third well-developed eye-lid, placed vertically at the internal angle of the two others. The direction of the eyes varies much. In Man, they are placed nearly straight forwards; but, as we descend in the series of Mammalia, towards those whose faculties are less developed, we see these organs becoming more and more lateral in their direction, until, among several, the sphere of vision is extremely different for each eye, so that the animal can scarcely see directly before him. This is particularly the case in such as are most liable to be pursued by others, and is an obvious adaptation to their timorous habits, giving them nearly as complete a survey of the country behind, as of that in front of them.

95. The apparatus of Hearing also, presents, amongst the Mammalia, some modifications which appear to be connected with the habits of the animals. Among those which live in the water or beneath the ground, the external ear is generally very small, or even altogether rudimentary; and, as we descend from Man to the Herbivorous Mammals, we find this part of the ear more and more trumpet-shaped, becoming more and more detached from the head, and also more movable. Among the Nocturnal Quadrupeds, the membrane of the tympanum generally occupies

more space, and is placed more on a level with the outer surface of the skull.

96. *Nervous System.*—The nervous system differs among the various Mammalia, only in the greater or less development of certain of its parts. In all these animals, the nervous mass contained in the head is very considerable, both in proportion to the extent of the body, and relatively to the size of the nerves; but all the organs which compose it do not equally agree in this development. Thus, the cerebral hemispheres are very large, whilst the optic tubercles or ganglia are very small, and even nearly rudimentary; and we shall hereafter see, that amongst Birds, Reptiles, and Fishes, it is quite otherwise. The cerebellum is of considerable size among the greater part of the Mammalia. It always consists of a central lobe of two hemispheres, which have their surface marked by transverse furrows; and of a commissure, or connecting band, which passes round beneath the spinal marrow. Moreover, the development of these parts varies much among the different Mammalia, not only as to their size, but also in regard to the channels and convolutions of their surface. For as we pass from Man to the Apes, from these to the Carnivora, and from the Carnivora to the Rodentia, and to the Herbivorous Animals, we generally see the brain become smaller and much smoother. It is also to be noticed that, amongst the Mammalia of the order Marsupialia, the brain presents another character of imperfection, resulting from the absence of the great central commissure, or *corpus callosum*, which, in all the other animals of the same class, connects together the two cerebral hemispheres.—(ANIM. PHYSIOL. § 458.)

97. *Functions of Nutrition.*—The functions of nutrition are performed among all the Mammalia very nearly as in Man; hence the structure of the organs destined for their exercise, varies but little in this great class of animals. It is in the digestive apparatus that the most important differences are exhibited. Nearly all the Mammalia are provided with teeth, destined to divide their food; but, as we have elsewhere seen (ANIM. PHYSIOL. § 182), the number and form of these organs varies according to the habits of the animal. These organs are sometimes re-

placed by horny plates, which among the Whales constitute the whalebone; and in another instance, again, the muzzle is prolonged into a very broad horny beak, flat, and furnished at the side with transverse plates; thus showing the greatest resemblance to the beak of the Duck, and causing the animal in which it exists to receive the name of *Ornithorhyncus*, or Duck-billed Platypus.

98. The conformation of the stomach varies much in the class Mammalia; and from these differences, physiological peculiarities of great importance sometimes result. In general, this organ is simple, as in Man, and the Monkey; but sometimes it is composed of a numerous series of distinct sacs; and in this case it generally happens that the food, after having remained some time in the first cavity of the stomach, returns into the mouth,—there to undergo a more complete mastication, before passing into the other portions of the digestive tube.—This phenomenon is known under the name of rumination. The number of the stomachs of the animals which ruminate (the Ox and Sheep, for example) is four. The first, which is the largest

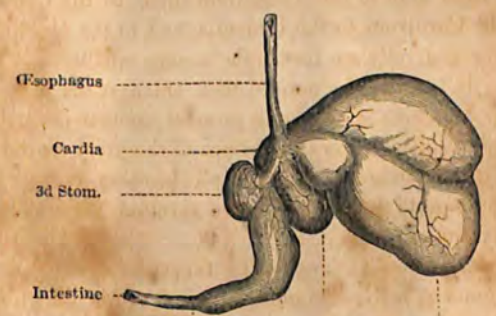

FIG. 64.—STOMACHS OF THE SHEEP.

of all, is named the *paunch*. Its internal surface is covered with papillæ, and is lined by a layer of the epidermis (Fig. 65). It occupies a large part of the abdomen, particularly on the left side. The second stomach, called the *honeycomb*, is small, and

is found on the right of the œsophagus, and in front of the third ; of which, at first sight, it seems to be an appendage. The mucous membrane which lines its interior, forms a multitude of folds, so arranged as to constitute polygonal cells, like those of a bee's comb. The third stomach, which is smaller than the second, is placed to the right of the paunch, and has received the name of *manyplies*, on account of the large longitudinal folds with which its interior is furnished, and which resemble the leaves of a book. The fourth stomach, or *reed*, which is intermediate in size between the paunch and the manyplies, is found on the right of this last sac. Its internal surface is irregularly folded ; and is continually moistened by an acid liquid—the gastric juice. It is on account of the property which this liquid possesses of curdling milk, that the reed of the calf is preserved as *rennet*, to be used in making cheese. The three first stomachs communicate directly with the œsophagus. This passage opens at first nearly equally into the paunch and the honeycomb ; and is then continued as a furrow or demi-canal (Fig. 65.) which runs along the

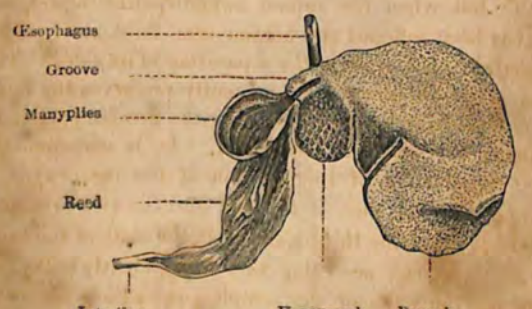

Fig. 65.—Section of the stomachs of the Sheep.

upper side of the honeycomb, and terminates in the manyplies, which, in its turn, communicates with the reed.

99. It is in the paunch, that the food, which is partially reduced by a first mastication, accumulates ; and it is only after having been brought back into the mouth, and chewed a second

time, or, in other words, *ruminated*, that it descends into the manyplies, and thence into the fourth stomach, which is the true seat of digestion. It is at first very astonishing to see the food descending, sometimes into the paunch and sometimes into the manyplies, according as the deglutition is taking place for the first time, or as the substances have been already chewed; and we might be almost tempted to attribute this phenomenon to a kind of *tact*, almost amounting to intelligence, with which the respective openings might be endowed. But the experiments of M. Flourens show clearly, that it is a necessary consequence of the anatomical arrangement of the parts; and they give an explanation of it equally simple and satisfactory. When the animal swallows, unchewed, the solid substances on which it generally feeds, these substances, having arrived at the point where the œsophagus is continued as a furrow or imperfectly-covered channel, mechanically separate the sides of this demi-canal (which is usually transformed into a tube by the contraction of these walls), and fall into the two first stomachs placed beneath; but when the animal swallows either liquid, or food which has been softened and become semi-fluid, their presence in this canal does not produce the separation of its sides. This last portion of the œsophagus consequently preserves the form of a tube, and conducts the whole food, or the greater part of it, into the manyplies, where it terminates. It is consequently the opening or shutting of this portion of the œsophagus, which determines the entrance of the food into the two first stomachs or its passage into the third; and it is the state of the food itself which decides this,—according as it is sufficiently bulky, or not, to separate the walls of the œsophagus, which are naturally pressed together,—or to flow through the channel that is always open, by which this passage leads towards the manyplies. The food, after its first deglutition, is only imperfectly divided, and consists of tolerably large pieces; whilst after having been again chewed, they are changed into a soft half-fluid paste; this circumstance is consequently sufficient to determine their fall into the paunch, or their passage into the manyplies. With regard to the regular regurgitation, by which the food contained in the

paunch and honeycomb returns into the mouth, *there* to be chewed, it has generally been attributed to the action of the second stomach itself, which has been supposed to take hold of a portion of the alimentary mass, to compress it so as to form a rounded ball or pellet, and then to send it into the œsophagus, whose progressive contractions from one end to the other complete the operation. But according to the recent experiments of the physiologist just quoted, it would appear that the paunch and the honeycomb by their contraction force the alimentary mass which they contain, between the borders of the furrow of the œsophagus; and that this, contracting in its turn, takes up a portion of it, separates it, and forms it into the ball which is destined to return along the œsophagus.—The paunch is, as we have already said, extremely large; but it is not always of the same size; and the differences which are observed in it, show how much the organs of animals may be modified by the circumstances in which they are placed. In fact, whilst the animals of the Ruminant tribe are young, and are living only on milk, the paunch is smaller than the reed; and only attains its enormous size when it has to receive grass, a substance that contains but little nourishment, and of which the animal is consequently obliged to eat a considerable quantity.

100. The intestinal canal, as elsewhere stated (ANIM. PHYSIOL. § 213), presents very considerable differences in its length and diameter, according as the food which has to pass through it has been obtained from the Animal or Vegetable kingdom. Thus, in many of the Carnivora its length is only about three or four times that of the body; whilst amongst the Herbivora it is usually from ten to twelve times, and sometimes nearly twenty-eight times this length (in the sheep, for example). In general, it terminates by a direct external aperture; sometimes, however, it enters a cavity named the *cloaca*, into which the urinary canals also open. This arrangement is found in the Ornithorhynchus; and is met with again in the class of Birds; hence it is an additional point of connection between that curious animal, and the oviparous vertebrata. The salivary glands, the liver, the pancreas, the peritoneum, and the other appendages of the digestive

canal, nearly always resemble those which occur in the human body.* (ANIM. PHYSIOL.)

101. This is the case also with the Circulating apparatus, and with the respiratory organs. The heart possesses, in every instance, four cavities; known as the two auricles, and the two ventricles (Fig. 66). The lungs are always divided into an im-

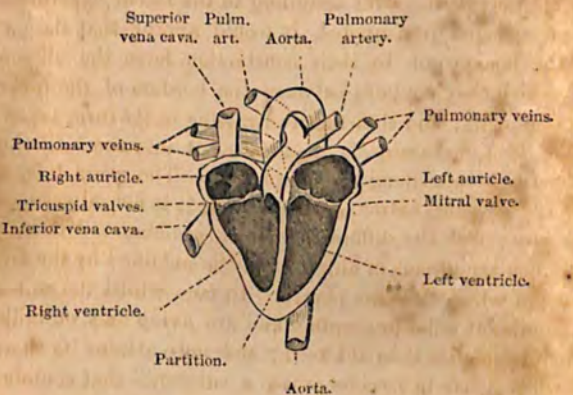

FIG. 66.—IDEAL SECTION OF THE HUMAN HEART.

mense number of very small cells, and do not allow the air to pass from their interior into the different parts of the body, as takes place amongst Birds. It is further to be remarked, that the blood in this class of animals is always very rich in organised matter, and that its red particles are nearly always of a circular form.

102. The Mammalia are, of all animals, those which approach the nearest to Man, in regard to their intellectual powers. But in this respect they present the greatest differences amongst themselves, which have been elsewhere noticed (ANIM. PHYSIOL. § 717); and if space would permit us here, it would be easy to multiply the proofs of this inequality. The study of the habits of the Mammalia would furnish us also with curious examples of the various kinds of instincts given by Nature to these beings, to supply the want of the more elevated faculties; the most im-

portant of these, however, will be considered in subsequent parts of this Treatise.

103. The class Mammalia is also, of all the divisions of the Animal Kingdom, that which interests us the most, on account of the services which it renders to Man. Indeed, it is to this that nearly all the domestic animals belong,—the Dog, the Horse, the Sheep, and the Cow, for example; and every one is aware how useful has been their subjection to us. Our dominion over these beings is become so complete, that the primitive race, living in a savage state, has in nearly every instance disappeared from the globe; and, by domestication, we are able to exercise a considerable influence even upon the physical forms and moral qualities of those individuals, which spring from the races that are thus subjugated (§ 12).—But by what power can we thus subjugate animals, and how, by domestication, can we modify their forms and qualities? The instinct of these beings leads them to fly from all which inspires them with distrust; it is, then, not by violence that we could compel a savage animal to obedience. It would not naturally be disposed to approach us, who are not of its own kind; and, at the first feeling of fear which we might cause it to experience, it would fly from us if it were free, or would take a dislike to us if it were in captivity. It is only by inspiring it with confidence, that we can attract it and render it familiar; and it is only by kindness that we can give birth to confidence.

104. To satisfy the natural wants of these animals, is one of the first means of bringing them into submission. The custom of receiving their food from our hand, by familiarising them with us, also attaches them; and, as the extent of a benefit is always in proportion with the need which is felt for it, their gratitude is also much greater and deeper, when the food that we give them is become necessary to them. Thus hunger is in our hands a powerful lever, to work upon all animals in captivity; for at the same time that it gives birth to affectionate sentiments, it produces a physical weakening, which, by reacting upon the will, weakens it in its turn. If, to the influence of hunger, we add that of choicely-selected food, and especially if we flatter their

taste with food which nature does not furnish to them, we excite in them a still greater gratitude; and they show, from an artificial treatment, new wants, which man alone can satisfy*; and, finally, to these means we may unite caresses also, the influence of which is very great over certain animals. When once, by habit and kindness, familiarity is established and confidence obtained, Man may make his authority felt, and may apply punishment, in order to transform any sentiments, whose manifestation he wishes to repress, into that of fear. By the association of ideas which results from this practice, the strongest of these sentiments is weakened by degrees, and is sometimes even at last completely destroyed; but the employment of force ought never to be without a limit, for excessive punishment often excites to revolt; and, at other times, when fear is carried too far, it disturbs the faculties. The prevention of sleep is also a powerful means of weakening the will of the animal, and of reducing it to obedience; for it does not know how to refer the fatigue and uneasiness which it experiences from it, to that which is really the cause of it: and in this state the affectionate feelings occasioned by kindness experience less resistance, and take root more deeply; whilst, on the other hand, fear acts with more readiness and force.

105. Thus we see, that it is through those wants over which we can exercise some influence, and by repressing the manifestation of certain feelings by the development of their opposites, that we are enabled to reduce animals to subjection. All the Mammalia are not, however, equally sensible to kindness; and, consequently, do not allow themselves to be subdued with the same readiness, or in so complete a manner. Their passions are often too violent for the animal ever to arrive at the mastery of them, and to become obedient to his master. Their natural distrust is often so great, and their excitability such, that we know not how to impose any rule of conduct on them; and in other instances, again, the intelligence of these beings appears too

* It is chiefly by means of sugar and other sweetmeats that horses and deer are trained to the extraordinary exercises which we sometimes witness in our circuses

confined for the remembrance of kindness to continue after its cause has ceased, and for them to associate in their memory the kindness and the benefactor.

106. By such means, we can reduce to more or less complete subjection a considerable number of animals; but between this state of individual subjection, and complete and hereditary docility, there is still a great difference. To obtain this last result, the animals must be in some degree predisposed to domestication, by the instinct of *sociality*, that is, the tendency to associate either with others of their own species, or with Man. In short, the feeling which leads them to live alone, and in some cases to fly from each other, or that which unites them into societies, and disposes them to be guided by a chief,—the strongest and most experienced of the number,—exercises the greatest influence upon their readiness to become domesticated. No solitary Mammalia, however easy it may be to tame them, have become completely domestic; whilst nearly all the animals whose race is subdued to the dominion of Man, live naturally in societies composed of a greater or smaller number. Sociality is one condition of domestication: and it is by developing to our benefit, and by directing towards us by our kindnesses, the feeling which leads these animals to unite with each other, that Man has been able to bind their existence to his; and to exercise over them the same authority, that the chief of the troop, of which they would have formed a part, would have possessed, if they had lived in their natural condition. It has been well shown by M. Fred. Cuvier, that the disposition to domestication may be considered as the extreme development of the instinct of sociality; and domestication itself as a state, in which the social animals acknowledge Man at once as a member and as the chief of their number.

107. We can now understand how Man can subjugate to his dominion entire races of animals. We shall next inquire how he is able to influence the forms and qualities, which belong to them from their birth: and to create, as we may say, new varieties at will. It is a physiological law, known to every one, that animals have a tendency to resemble their parents, not only

in their general conformation, but also in whatever peculiarities may distinguish the latter. In the Human species, for example, hereditary influences are manifested in a number of forms. Bodily constitutions, mental faculties and characters, even infirmities, are bequeathed from generation to generation; and in animals among which fewer external circumstances act upon the individuals, producing irregularities in this repetition of the same forms and qualities, the tendency of the young to resemble the authors of their existence is still more evident. Now all the individuals of the same species do not possess, to the same degree, the physical, moral, and intellectual qualities, with which each of them is endowed; and by the exercise or the influence of physical conditions, we can develope a particular faculty, and consequently increase these differences. It follows, then, that Man may, within certain limits, modify races at his pleasure; for he is able to choose, or even to produce, individual differences, which are transmissible from one to the other; and to regulate the succession of generations, so as to remove from them all that would tend to separate the race from the type which he wishes to produce; and he can thus influence the hereditary qualities of the young, as he had done those of their parents. It results, therefore, from this, that at each new generation, he advances a step nearer to the end that he proposed to himself; for he acts upon individuals already affected by the modifications that had been impressed upon their parents.

108. A very good example of the degree in which *accidental* peculiarities, appearing in a single individual only, may be taken advantage of by Man, for some purpose useful to him, is of comparatively recent occurrence. In the year 1791, one of the ewes on the farm of Seth Wright, in the state of Massachusets, produced a male lamb, which, from the singular length of its body, and the shortness of its legs, received the name of the *otter* breed. This peculiar conformation, rendering the animal unable to leap fences, appeared to the farmers around so desirable, that they wished it continued. Wright determined on breeding from this ram; but the first year only two of its offspring were marked by the same peculiarities. In succeeding

years, he obtained greater numbers; and when they became capable of breeding with one another, a new, and strongly-marked variety, before unknown to the world, was established. —This example shows the influence which a scanty population may have formerly had, in the production of varieties, both in the Human and other species. At the present time, the natural tendency is for any peculiarity of this kind to be speedily lost, by the intermixture of the individuals which exhibit it with the large proportion of those in which it is absent;—unless this be prevented, as in the instance just cited, by the interference of Man. But it may be imagined that, in the earlier ages of the world, some individuals in which a peculiarity existed, may have been so far separated from the rest, that frequent union took place among themselves; so that the character would be rendered still more marked, instead of disappearing; and, being propagated for a few generations, would be rendered permanent in this manner. Thus by the force of circumstances, the same creation of a new race would be effected, as the breeder of animals now accomplishes by the system he adopts.

109. It is easy to adduce many instances, in which peculiarities that have been developed by education, or by the influence of particular circumstances on the constitution, have become hereditary. The peculiar habits of the various kinds of Dogs used in sporting, were doubtless, for the most part, originally forced upon them (as it were) by education; but they now become almost a part of their constitution. Thus it is not only much easier to teach a young Dog of the Pointer breed to *point* game, than it is to teach a dog of any other breed to do the same; but a Pointer puppy, when first taken into the field, will sometimes perform its peculiar duty nearly as well as an old and experienced dog. The same has been noticed of the Retriever, a breed of dogs whose duty it is to stay by their master until the game falls wounded, and then to bring it in;—a habit which might have been supposed to be still less likely to be transmitted, because more unlike the ordinary habits of the species. It would seem, however, that habits of this kind, which have been grafted upon an individual by education, are

not transmitted to the offspring, when they are entirely wanting in relationship to the natural condition of the animal. Thus, by a long and laborious training, a Pig has been taught to *point* game; but there is no reason to believe that a *breed* of Pointer Pigs could be established.

110. The following examples will show the influence of climate, and other circumstances affecting the bodily constitution, in modifying the character of a race. It is well known that the Spaniards, when they first invaded America, introduced a large number of blood-hounds; which had been previously trained to hunt stags, but were then directed by these savage (though professedly civilized) conquerors against their fellow-men. Similar dogs have been since employed in the West Indian Islands, and in Florida; and, by a most disgusting kind of education, have been taught to distinguish and pursue the black and coloured races, without showing any animosity towards white men. Now of the descendants of the original stock, a considerable portion have degenerated, under the influence of insufficient nourishment, admixture with other races, &c. But among some of these, new instincts have sprung up, conformable to their altered circumstances, and have become hereditary. Thus, on the banks of the Magdalena, they are employed in hunting the white-lipped Pecari, which associate in herds, and require a peculiar mode of attack. The address of these dogs consists in restraining their ardour, and attaching themselves to no animal in particular, but keeping the whole herd in check. Now among these dogs, some are found, which, the very first time they are taken into the woods, show themselves to be acquainted with this mode of attack; whereas, a dog of another breed starts forward at once, is surrounded by the Pecari, and, whatever may be his strength, is destroyed in a moment.—Some Englishmen, who were engaged in conducting the operations of the Real del Monte Company in Mexico, carried out with them some Greyhounds of the best breed, to hunt the hares which abound in that country. The great platform which is the scene of the sport, is at an elevation of about 9000 feet above the level of the sea; and the mercury in the barometer stands habitually at the

height of about 19 inches. It was found that the Greyhounds could not support the fatigues of a long chase in this attenuated atmosphere; and before they could come up with their prey, they lay down gasping for breath; but these same animals have produced whelps, which have grown up, and which are not in the least degree incommoded by the want of density in the air, but run down the hares with as much ease as the fleetest of our races in this country.

111. By endeavouring, then, to develope from generation to generation, a particular quality, or physical peculiarity, we may carry it much further than it would have been possible to do at first: and we thus can create artificial races, of which the characters will only be effaced, when the opposite circumstances to those which have occasioned these peculiarities, come to destroy the effect of them. It is in this manner that we accomplish our end, when a powerful interest gives perseverance to our efforts; and thus it is, that in the present day races of Sheep, Oxen, and Horses have been produced,—characterised by the most remarkable peculiarities. It has been observed, for instance, that Sheep which present certain peculiarities of conformation, are fattened much more easily than others; and Bakewell, one of those who have rendered the greatest services to English Agriculture, having taken care to cause the Sheep amongst which these external characters were seen in a high degree, to breed with each other, was able to create a race of great value in this respect. The weight of the four quarters of the carçass of the large Sheep of the Wurtemberg breed,—which was introduced into some of the provinces of France, as being particularly good for the purposes of the butcher,—was from 52 to 55 per cent. of the total weight of the animal; whilst in the English Sheep of the Dishley or New Leicester breed, this proportion was raised to 70 or 75 per cent. It is also known to Agriculturists, how much the fineness of the wool is increased by similar care; and how much, in this respect, our native breeds have been improved by their mixture with the Merinos of Spain.

112. Again, the different races of Horses, which are of so high an interest to us, are also a proof of the influence of Man

over the animals living under his dominion. The horses which are reared in our breeding establishments, partly owe their size, their form, and their qualities, to the race from which they are descended; but the circumstances in which they are placed at an early age, exercise over them, in process of time, an influence not less great. It is remarked, that in general the colt receives its size and weight more from its mother than its father; whilst in the shape of the head and feet, its courage and swiftness, it more resembles the latter. Defects, moreover, as well as good qualities, are transmitted from generation to generation; and, to maintain a race in its purity, or to improve it, care must be taken to remove from it all those individuals, which do not possess the qualities that we desire to obtain. In order to make a blemish disappear, we cross the individuals of this defective race, during several generations, with others having an opposite disposition; and by perseveringly matching together horses which possess particular perfections, we create a race in which they become hereditary and general. It is owing, in a great degree, to care of this nature, that the Arab horses owe their well-merited celebrity. The Arabs attach such importance to the purity of the race of their noble horses, called *kochlani*, that their descent is always attested by authentic pedigrees. They can even go back nearly two thousand years, in the genealogy of these fine animals; and there are some whose lineage can be attested by written documents, during a period of four centuries. On the other hand, the influence of crossing a race is equally well shown by the English race-horses; for it is by a mixture of the native mares with the males brought from the East, that we owe the creation of this race, so remarkable for the delicacy of its shape, and its astonishing fleetness.

113. Again, the greater or less abundance and the quality of the food, the dryness or humidity of the country, the daily labour, and even a number of circumstances apparently of very little importance, exercise a powerful influence upon the shape, the size, and the qualities of horses. To give a proof of this, we might show with what rapidity the finest English

horses degenerate in certain localities, such as the neighbourhood of Kopschan, upon the borders of Moravia; but without going so far, we shall find still more striking examples of the modifying power of external circumstances. If of two colts sprung from the same race, in Lorraine, for example,—one is transported into Flanders and the other into the pastures of Normandy, instead of preserving the same characters, they will present, at the age of five years, nearly as much difference as if they had proceeded from two distinct races. One will become a light and elegant carriage-horse; the other an enormous animal, almost incapable of going a trot, but fitted to draw the heaviest loads at a slow pace. Where food is abundant, and where by the foresight of man it never fails at any season, the horses are generally large and fat; whilst in countries where it is less abundant, even during but one season of the year, these animals only acquire a small or middle size. Physiologists have proved something similar to this, in studying the laws of the growth of Man; and to be convinced of the truth of this observation relatively to horses, it is sufficient to compare those which, in the same country, belong to the poor labourer or to the rich landowner. Pasturage in rich and damp meadows, such as are most suitable to fatten cattle, tends to give to horses a heavy and clumsy appearance; to render their skin thick, and their hair coarse, and to diminish the vivacity of their character. The food supplied by dry meadows produces no such effect; and, when it has been rendered still firmer by the addition of a considerable proportion of corn grains, it becomes eminently fitted to preserve, and even to produce, the elegance of form and the muscular energy which are characteristic of a noble race. When a somewhat lower temperature adds its influence to that of dampness, and of abundant and watery food, the horses acquire a much heavier form, but become, at the same time, much less energetic, and more inert. In very cold or very hot countries, on the contrary, the growth is checked much sooner; and even the largest races soon lose their high stature. Again, the daily attention which is given to some horses, and of which others are completely destitute, also has its effect upon

the beauty of these animals; thus the frequent rubbing, the use of coverings, the precaution of washing and drying the extremities, and even of surrounding them with bands of flannel, are circumstances which contribute powerfully to give to the horses of our own country that neatness, which is remarked in the lower part of their limbs, and to render their skin and their hair so soft and fine.

114. Thus, by modifying the circumstances in which an animal is placed, we impress certain modifications on its structure; and by employing for the propagation of the race only the individuals thus modified, Man gives to the entire race a particular character, and developes in it qualities which it did not at first possess. It is probably in this way that he has obtained the various races of Dogs, whose forms are so different, that at first sight we can hardly believe that they belong to one and the same species. But this modifying power is always restrained within certain limits; and it never effaces the distinctive marks, which serve as the zoological characters of the species.

115. *Classification of Mammalia.*—There exist, as we have already seen, considerable differences amongst the Mammalia; and these modifications serve as a basis for the division of this class into groups of an inferior rank, named *Orders*. The greater part of these groups are so clearly separated from the surrounding ones, that there can be no doubt regarding their limits; and all Zoologists have agreed to admit them as forming such natural divisions. But in others the principal type is so modified, that an almost insensible passage is made from the one to the other, and it becomes very difficult to draw the line of division. A certain Mammal, for example, has quite as much analogy with the type which represents the order Quadrumana, as with that of the Rodentia; and it may with nearly as much reason be placed in the one as in the other of these divisions.

116. It has been elsewhere explained (Anim. Physiol. § 750), that the essential peculiarity which distinguishes the reproductive process in the Mammalia, is not so much that the egg is retained within the body of the parent, so that the young is born

alive,—for this happens in certain animals belonging to nearly all the oviparous classes, such as Insects, Fishes, and Reptiles: but that the young animal is developed by means of nutrition directly supplied to it by the parent, through a system of blood-vessels partly belonging to the embryo, and partly to the *uterus* or cavity in which it is contained. In oviparous animals, the development is effected at the expense of the store of nourishment laid up in the egg itself; but this is very small in the Mammalia, because, at a very early period of its growth, the embryo begins to draw its support directly from the parent. From the surface of the *chorion* (which is the membrane that covers the egg, resembling that which lines the shell in Birds), a number of little tufts shoot out, and insinuate themselves amongst the vessels of the uterus, from which they absorb a nutritious fluid, that ultimately finds its way to the embryo. This is the sole mode in which the embryo of the non-placental Mammalia is ever connected with the parent: but in the truly viviparous sub-class, a more direct communication is subsequently effected, by a set of vessels proceeding from the embryo itself, which forms, by the minuteness of its subdivisions, a mass of considerable size and solidity, known as the *placenta;* this is applied against the interior of the uterus, and draws nourishment from its vessels, much in the same way that the roots of a tree imbibe moisture from the soil, or that the lacteal vessels, spread out upon the walls of the intestine, take up fluid from its cavity. Thus, the non-placental Mammalia stop short, as it were, at a period of development, which is very early or incomplete as regards the higher subdivision of the class.

117. The method of division that we shall here adopt is very nearly that of Cuvier. It rests principally upon the differences which the Mammalia exhibit in their mode of development, in the conformation of their limbs, and in their apparatus of mastication; parts whose modifications always involve a number of other differences in the structure of the various parts of the body, in their habits, and even in their intelligence. When we take the whole of these characters into account, we are led first to divide the class of the Mammalia into two sub-classes, which

may be termed the *placental* or *truly viviparous*, and the *non-placental* or *ovo-viviparous* Mammalia. The *truly viviparous* Mammalia are the most numerous; and are principally distinguished by the mode of their development. They do not come into the world until they are provided with all their organs; and, before their birth, they derive their support from a net-work of maternal blood-vessels, named the *placenta*. It is also remarked, that their brain is more perfect than that of the ovo-viviparous Mammals; its two hemispheres being united together by a large commissure, or band of connecting fibres, termed the *corpus callosum* (§ 96); lastly, the walls of the abdomen are never supported by bony projections fixed on the edge of the pelvis, such as we shall see in the second grand division of this class. The Mammalia, thus organised, differ very much amongst themselves in the general conformation of their bodies; some being adapted to inhabit the air, as the Bats; others resembling Fishes, as the Whales; whilst the ordinary Mammalia are formed to live more or less completely on the earth.

118. In the *non-placental* or *ovo-viviparous* Mammalia, on the other hand, there are several points of structure which show that they are to be regarded as an inferior group—intermediate between the higher group whose characters have just been given, and the Oviparous Vertebrata. The young are born in an extremely imperfect state, closely resembling that of the young of the other Mammalia when they come into the world very prematurely; and as they do not remain long enough within the interior of the parent to give time for the formation of the *placenta*, they are properly distinguished by a term which expresses its absence. The term *ovo-viviparous* is not so correct a designation, in a scientific point of view; since it applies more properly to those animals just alluded to (§ 116), in which the animals are really oviparous, but in which the young are born alive, by the retention and hatching of the eggs within the body of the parent: but it serves to express, in a popular manner, that this division is intermediate between the truly viviparous Mammals, and the truly oviparous classes of Vertebrata, which is shown to be the case in many points of their structure. Of these, the two

most remarkable have already been noticed—the deficiency of the *corpus callosum*, or band of fibres connecting the two hemispheres of the brain;—and the termination, at least among the lowest of them, of the intestinal canal and the urinary ducts, with the uterine passage, in one common receptacle, as in Birds and Reptiles (§ 100). In accordance with the general rule,—that the less the amount of assistance given to the germ of a vegetable or animal in its early development, the lower is the grade which it ultimately attains, we find that in many points of their conformation, as well as in their degree of intelligence, the non-placental Mammalia are much inferior to the truly viviparous portion of the group. The former are further distinguished by the presence of the *marsupial* bones (§ 90), even when there is no external pouch.

119. The Placental Mammalia are subdivided into orders chiefly by the structure of their extremities, and of their teeth; with which, as has been already shown, a great part of their internal conformation is closely connected (§ 58). Thus we distinguish the *Unguiculated* Mammals, which have separate fingers, terminated by distinct nails or claws; and the *Ungulated*, in which the fingers are more or less consolidated, and inclosed at their extremity in a hard hoof. Ungulated animals are necessarily *herbivorous;* inasmuch as the conformation of their feet precludes the possibility of their seizing a living prey; and they have flat-crowned grinding teeth for triturating their food. The summits of these teeth are usually not covered by a smooth coat of enamel, but present a series of elevations and depressions; these are occasioned by the peculiar structure of the teeth, which consist of alternating plates of *enamel*, ivory or *dentine*, and *cementum* or bony substance; and as these three substances are of different degrees of hardness, their unequal wear will keep the surfaces constantly rough.—Among the Unguiculated Mammals, we find more variety as to the character of the food. In some it is almost exclusively vegetable, as in the Rodentia (Rat and Squirrel tribe); but here the power of the separate fingers is the least possible, the bones of the fore arm and leg being so constructed, that the hand cannot be turned

round by the movement of one of these bones on the other (ANIM. PHYSIOL. § 639). In this order, the mouth is remarkably adapted for grinding down hard vegetable substances; the molar teeth being furnished with transverse ridges of enamel, and the jaws having a powerful movement forwards and backwards. In others, again, there is an almost exclusive adaptation to animal food; and in these we find the unguiculated structure in the highest perfection, the claws being sharp and long, and the hand or fore-foot being capable of being placed in a great variety of positions, by the rotation of the two bones of the leg. The grinding teeth are very narrow, and are raised into sharp points and edges, so as to be adapted for dividing animal flesh; and these are firmly set in short strong jaws, which are fitted together like the blades of a pair of scissars, having no action but a vertical one. In this group, too, we find the greatest development of the canine teeth; which are commonly absent, or but slightly developed, among herbivorous quadrupeds. These are the most powerful weapons with which carnivorous animals are furnished; serving both for the first attack of their prey, and for subsequently tearing it in pieces. To this division, also, belongs the Bat tribe, in which the extremities are provided with distinct claws, and the teeth adapted (for the most part, at least) to an animal diet; and to it we are also to refer a portion of the Fish-like Mammals, in which the structure of the teeth and digestive apparatus is closely allied to that of the Carnivora, as is the case in the ordinary Whales and their allies; whilst another portion, consisting of but a few species, is to be referred to the herbivorous division, on account of a similar conformity in general structure.

120. Among the Unguiculated Mammalia, there are some which have the power of *opposing* one of the fingers to the rest; and this, either on the two anterior extremities alone, or on the posterior also. This is a character, which is so closely connected with the general conformation and habits of the animals that possess it, as to be of the highest importance in classification: and accordingly it serves to distinguish the two first orders or the Unguiculata from all the rest. These orders are:—

I. BIMANA, or *two-handed* Mammals; so termed from the restriction of the thumbs or opposable fingers to the anterior extremities only, which are employed for *prehension*, whilst the posterior are employed for *locomotion*. By this character, and by his naturally erect position, Man is distinguished from all other animals; and consequently this order is composed of the Human Races only. We shall presently see that, however various the characters of different races, they are all entitled to rank as belonging to the same species. The order Bimana is further distinguished by the number and character of the teeth; —there being 4 Incisors or cutting-teeth in each jaw; Canine teeth in each jaw, moderately developed; and (in the adult, in whom the last molars or wise teeth have been cut,) 5 Molar teeth, having rounded or tuberculated summits, on each side of each jaw. It is usual, in order to express briefly the number of teeth in the jaws of an animal, to use the following method :— Those of the upper jaw are placed above a horizontal line, and those of the lower jaw below it; like the numerator and denominator of a fraction; thus, $\frac{6}{4}$ would mean that there were 6 teeth of a particular kind in the upper jaw, and 4 in the lower. The incisors, being all together in the centre, are specified by a single number; but the canines and molars, which are found on either side, are expressed by two numbers,—as thus 4—4, meaning that there are 4 on each side. Hence the *dental formula*, as it is termed, of Man, is as follows; incisors $\frac{4}{4}$, canines $\frac{1-1}{1-1}$, molars $\frac{5-5}{5-5}$. The value of such a short and simple expression will hereafter become evident.

II. QUADRUMANA, or *four-handed* Mammals, embracing the Monkey tribe; so termed from the possession of thumbs on all the four extremities (in part of the group), thus giving to all of them, in greater or less degree, the peculiar power of prehension which this conformation imparts. But they are all, likewise, concerned in locomotion also; as the distinction between the anterior and posterior extremities, which is so remarkable in Man, does not here present itself, or is only seen in a slight degree. The number of incisors is still $\frac{4}{4}$, and of canines $\frac{1}{1}$: but that of the molars is $\frac{6-6}{5-5}$, in a certain part of the group.

121. We may further separate from the other Unguiculated Mammalia, by very obvious characters, the following order:—

III. CHEIROPTERA, or *wing-handed* Mammals; a group which is identical with the *Bat* tribe. The peculiar adaptation of the anterior extremities of these animals for *flight*, by the enormous development of the bones of the fingers, and by the extension of the skin over them, so as to form a widely expanded *wing*, distinguishes them from all other Mammals. The teeth do not here afford so distinctive a character; being somewhat irregular in number, and of great variety of forms,—most of the species being adapted to feed on Insects, but some of them, like the greater part of the Monkeys, being formed to subsist on fruits and other soft vegetable substances.

122. The remainder of the Unguiculated Mammals may be first arranged, according to the presence of all three kinds of teeth, or the absence of some of them. Those which have incisors, canines, and molars, are destined to live on animal food; but this may be of two kinds, either the bodies of insects, or animal flesh. Hence, we have no difficulty in distinguishing the two following orders:—

IV. INSECTIVORA, or *insect-eating* Mammals; a term which might be applied to many animals in other groups, such as the Bats, and even some Quadrumana; but which is peculiarly characteristic of these—the form of their teeth, and their whole economy, being adapted to the capture, mastication, and digestion of hard-bodied beetles, locusts, &c. Their teeth are easily distinguished by the conical elevations they present, which differ on the one hand from the rounded summits of those of animals destined to feed on soft animal or vegetable substances indiscriminately, and from the sharp edges of those of the truly carnivorous Mammals. Their number is somewhat irregular; but there are usually 6 incisors and 2 canines in each jaw.

V. CARNIVORA, or *flesh-eating* Mammals; which are at once known from all others, by the possession of six incisor teeth in each jaw, two long canines, and a variable number of molars, of which some are provided with cutting edges. They are pre-eminently *beasts of prey;* and their whole conformation is

adapted to their habits. Some of these, as the Seal, pass a large portion of their time in the water, and have the extremities formed for swimming; and these naturally lead us, therefore, towards the next order.

VI. CETACEA, or *fish-like* Mammals; which are distinguished from all ordinary mammalia by the absence of the posterior extremities, and by the conversion of the anterior into swimming paws or paddles. Of the animals thus adapted to the life of Fishes, however, those only are included in this order which are carnivorous in their habits, and whose alimentary canal is formed to digest animal food.

123. The unguiculated Mammals which do not possess the three kinds of teeth, are divisible into two orders, which exhibit the unguiculated structure in its lowest grade.

VII. RODENTIA, or *gnawing* animals; a group very easily distinguished by the peculiar conformation of the front teeth, which are two in each jaw, very strong, with sharp cutting edges, and constantly growing at the roots; thus forming admirable instruments for gnawing. Of this group, the Squirrel, Rat, Beaver, &c., are examples. The canine teeth are altogether absent, and between these chisel-like incisors and the molars there is a large gap in both jaws. The number of molars is variable; but they are all formed with ridges of enamel, placed more or less transversely to the jaw.

VIII. EDENTATA, or *toothless* animals; a term which is not altogether correct, but which serves to express the character of a large proportion of the order designated by it. This group is properly characterised by the entire absence of *front* teeth in both jaws; and in the Ant Eaters, &c., there are no teeth whatever; whilst the Sloths are possessed of molar teeth, though of very imperfect formation.

124. The ungulated, or hoofed Mammals, are easily subdivided into two orders, by the presence or absence of the *ruminating* faculty, and of the peculiar conformation which appertains to it (§ 98).

IX. RUMINANTIA, or *ruminating* animals; a group which is composed of the Ox, Sheep, Antelope, Camel, and other well-

known animals; all of which agree in possessing the ruminating apparatus, as well as in having the hoof cleft (or rather double); and nearly all in the following dental formula:—incisors $\frac{0}{6}$, canines $\frac{0-0}{0-0}$, molars, $\frac{6-6}{6-6}$, the last being marked on the surface with crescents, which are formed by ridges of enamel.

X. PACHYDERMATA, or *thick-skinned* animals; a group that includes a great variety of dissimilar forms, which agree rather in the absence of other characters, than in the possession of any that are common to all. Thus the Elephant, Horse, and Pig, would seem to possess very different types of structure,—the Elephant having the bones of its toes distinct, but included together in a sort of horny skin,—the Pig having four distinct toes, with separate hoofs,—and the Horse having all the bones of the toes consolidated into a single row, which is terminated by a single hoof. The characters afforded by the teeth are equally various; some having incisors, others none; some having large canines, others small ones, and others being destitute of them; and the number of molars also being subject to great variation. Yet these very dissimilar forms are connected by intermediate links, recent and fossil (§ 28); and it appears as if we were to unite with this order those whale-like animals, whose food is of a vegetable character,—their whole conformation being very different from that of the true Cetacea, and more closely resembling that of certain aquatic Pachydermata.

125. The foregoing arrangement of the orders of the viviparous Mammalia is more adapted to distinguish them from each other, than to represent their relative positions in a natural series. Thus, the Edentata and Rodentia are unquestionably lower, in regard to their intelligence and their general conformation, than the Ruminantia and Pachydermata; and the Rodentia are those, among the truly viviparous Mammals, which approach the nearest to the non-placental group, in the low development of their brain; as well as in several points of their general structure. It is impossible to represent their mutual relations by any arrangement of them in a single line; since each group has connections, not only with those before and behind it, but with others at a distance. Nevertheless it is

necessary to follow *some* order in the more particular description of them; and the following is probably the most correct, in regard especially to the *grade* which the different groups possess in the scale. I. BIMANA. II. QUADRUMANA. III. CHEIROPTERA. IV. INSECTIVORA. V. CARNIVORA. VI. CETACEA. VII. PACHYDERMATA. VIII. RUMINANTIA. IX. EDENTATA. X. RODENTIA. Thus from Man we pass to the Quadrumana by the Apes which most nearly resemble him in bodily structure. From these we descend to the Lemurs, in which the teeth show an insectivorous character, and certain species exhibit a tendency to the formation of organs of flight; by which characters we are conducted to the Cheiroptera, or Bats. From the insectivorous forms of these, the transition is not difficult to the proper Insectivora; which, again, lead us to the Carnivora; and these, by their aquatic species, to the Cetacea. From the Cetacea we naturally pass to the whale-like Pachydermata; and then, through the terrestrial tribes of these, to certain species which conduct us to the Ruminants. The Edentata and Rodentia are not closely connected, by any existing species, with either of the two last orders; but there are certain fossil forms, which seem to link them to both.

126. The division of non-placental Mammalia contains two orders only, which are chiefly distinguished by certain peculiarities affecting the reproductive apparatus.

XI. MARSUPIALIA, or *pouched* animals; being those in which the young are carried during the early part of their lives, in a *marsupium*, formed by folds of the skin of the abdomen, which are supported by peculiar bones. The species included in this group differ greatly among each other, both in the general form of their bodies, and in the conformation of their teeth and digestive apparatus. Indeed they bear, in these respects, a striking resemblance to animals of different orders among the truly viviparous Mammals. Thus, the Opossums have an opposable thumb on all four extremities; so that they are truly quadrumanous, or four-handed. Others, again, bear a close resemblance to the Carnivora; and others to the Rodentia; so that the order Marsupialia was really distributed amongst these groups, when the

principles of classification were not so well established as they are at present. But it is now almost universally considered, that the absence of the placenta, connected as it is with the low development of the brain, and with other evidences of an inferior grade, is a character of the most *essential* nature, completely distinguishing the animals by which it is manifested, from any to which they may bear a general resemblance in *adaptive* characters (§ 25). And this can be hardly otherwise than true; since we find that the Marsupialia, taken as a group, have more points of real agreement with each other, than any of them have with animals of other orders.

XII. MONOTREMATA, or animals with a *single outlet;* a character which has been already explained (§ 117). This order is very limited, containing only two genera; which are sometimes placed among the Edentata, on account of the absence of teeth in their jaws. They are altogether most remarkable animals; and present several points of the greatest interest both to the Physiologist and Zoologist,—as do generally, indeed, those animals which stand on the borders of two great divisions.

ORDER I.—BIMANA.

127. The name Bimana is the most appropriate that could be found for an order constituted by the human species only; for Man alone is two-handed. "That," says Cuvier, "which constitutes the *hand*, properly so called, is the faculty of opposing the thumb to the other fingers, so as to seize the most minute objects,—a faculty which is carried to its highest degree of perfection in Man, in whom the whole anterior extremity is free, and can be employed in prehension." Some Naturalists refuse the term *hand* to the extremities of the Monkey tribe, preferring to call them *graspers;* for it is certainly true that, although most of them possess an opposable thumb, yet they are destitute of the power of performing many of those actions, which we regard as most characteristic of the hand. These actions are dependent upon the size and power of the thumb, which is much more de-

veloped in Man, than it is in even the highest Apes. The thumb of the Human hand may be made to meet, at its point, the extremities of each finger singly, or of all in combination; whilst in those Quadrumana, which most nearly approach Man, the thumb is so short and weak, and the fingers so long and slender, that their tips can scarcely be brought in opposition, and can never be *opposed* in near contact with each other with any degree of force. Hence, although admirably adapted for clinging round bodies of a certain size, such as the small branches of trees, &c., the extremities of the Quadrumana can neither seize very minute objects with that precision, nor support large ones with that firmness, which are essential to the dexterous performance of a variety of operations, for which the hand of Man is admirably adapted. Hence the possession of *four* hands is not, as might be supposed, a character which raises the animals that possess it above *two*-handed Man; since none of these four hands are adapted to the same variety of actions of prehension, of which his are capable; and all of them are in some degree required for support. In this respect, their character approaches much nearer to that of the extremities of the lower Mammalia.

128. We ought, then, as Sir Charles Bell remarked, "to define the hand as belonging exclusively to Man." There is in him, what we observe in none of the Mammalia that approach him in other respects,—a complete distinction between the functions of his two pairs of extremities; the upper being adapted for prehension alone, the lower for support only. Thus each function is performed with a much higher degree of perfection than it can be, where two such opposite purposes have to be united. The arm of the Ape has as wide a range of motion as that of Man, so far as this can be given by the joints; but it is only when the animal is in the erect attitude, that its arm can have free play. Thus the structure of the whole frame must conform to that of the hand, and must act with reference to it. But it cannot be said with truth, (as some have maintained,) that Man owes his superiority to his hand alone; for without the directing mind, the hand would be comparatively valueless. His elevated position is due to his mind and its instruments con-

jointly; for, if destitute of either, the Human race would either be speedily extinguished altogether, or would be reduced to a kind of life not above the level of that of the brutes.

129. Man is further distinguished from all other animals by his erect attitude; which involves a considerable number of modifications in his general structure. Thus, his head is set upon the top of the spinal column in such a manner, that its weight bears directly downwards upon it; and it is so nearly balanced, owing to the position of the articulation on which it is supported, that very little muscular exertion is required to keep it in the erect position. Now if, with the same form of the head and neck, Man had been destined to walk upon all-fours, the head would have been without proper support; since the neck of Man is destitute of the powerful muscles and ligaments by which the large heads of the herbivorous quadrupeds are sustained in this position, (ANIM. PHYSIOL. § 29): and the face would be directed towards the ground, instead of commanding the horizon around. Among those Quadrumana which most nearly approach Man, we find that the point on which the head is supported is placed much further back than in him; and that it bears obliquely on the spinal column. This corresponds with the semi-erect position which seems natural to them,—the spine being inclined forwards, so that the body is partly supported upon the anterior extremities; and in this state, the face looks directly forwards. But these animals occasionally assume the completely-erect, or the completely horizontal posture; and they can easily adapt the position of the head to either of these, its usual angle being intermediate between them.

130. The position of the face immediately *beneath* the brain, so that its front is nearly in the same plane with the forehead,—making the *facial angle* (ANIM. PHYSIOL. § 719) large,—is peculiarly characteristic of Man; for the brains of the Chimpanzee and Orang, which approach most nearly to that of Man, are almost entirely *behind*, and not above, the face. In the *young* Ape, however, there is a much greater resemblance to Man, in this respect, than there is in the adult. For at the time that the second set of teeth appears, the muzzle of the Ape undergoes a

great increase in length, so that it projects much more beyond the forehead. The whole cast of the features is altered at the same time; so that it approaches more nearly to that of the Baboons, and other inferior Quadrumana, than would be supposed from observation of the young animal only. This increased projection of the muzzle is an evidence of want of perfect adaptation to the erect posture; whilst the absence of it in Man shows that no other position is natural to him. Supposing that, with a head formed as at present, he were to move on all-fours, so that his face would be brought into the same plane with the ground,—as painful an effort would be required to examine with the eyes an object placed in front of the body, as is now necessary to keep the eyes fixed on the zenith; the nose would be unable to perceive any other odours than those which proceed from the earth, or from the body itself, their aperture being directed backwards; and the mouth could not touch the ground to take up food (which it must have done if the anterior limbs were used for support), without bringing the forehead and chin also into contact with it.

131. The vertebral column in Man, though not absolutely straight, has its curves so arranged, that, when the body is in an erect posture, a vertical line from its summit would fall exactly on the centre of its base. It increases considerably in size in the lumbar region, so as to be altogether somewhat pyramidal in form; and it is set upon the sacrum by a very broad base. The iliac bones are widely expanded, so that the whole pelvis is very broad; in this manner the hip-joints are thrown farther apart from each other, so as to give a firmer basis of support. The breadth of this is still further increased by the oblique position of the *neck* of the thigh bone. The position of this bone, in which its head is most secure in its deep socket, is when it is supporting the body in a vertical position,—that is, when it has the same direction with the spinal column. In the Chimpanzee and Orang, on the other hand, the most secure position is when the spinal column is bent forwards at an angle upon it; in several other Mammals, as the Elephant, the spinal column forms a right angle with the thigh bone; and in many others, as the Horse, Ox, &c., the angle is less than a right angle, the thigh-bone

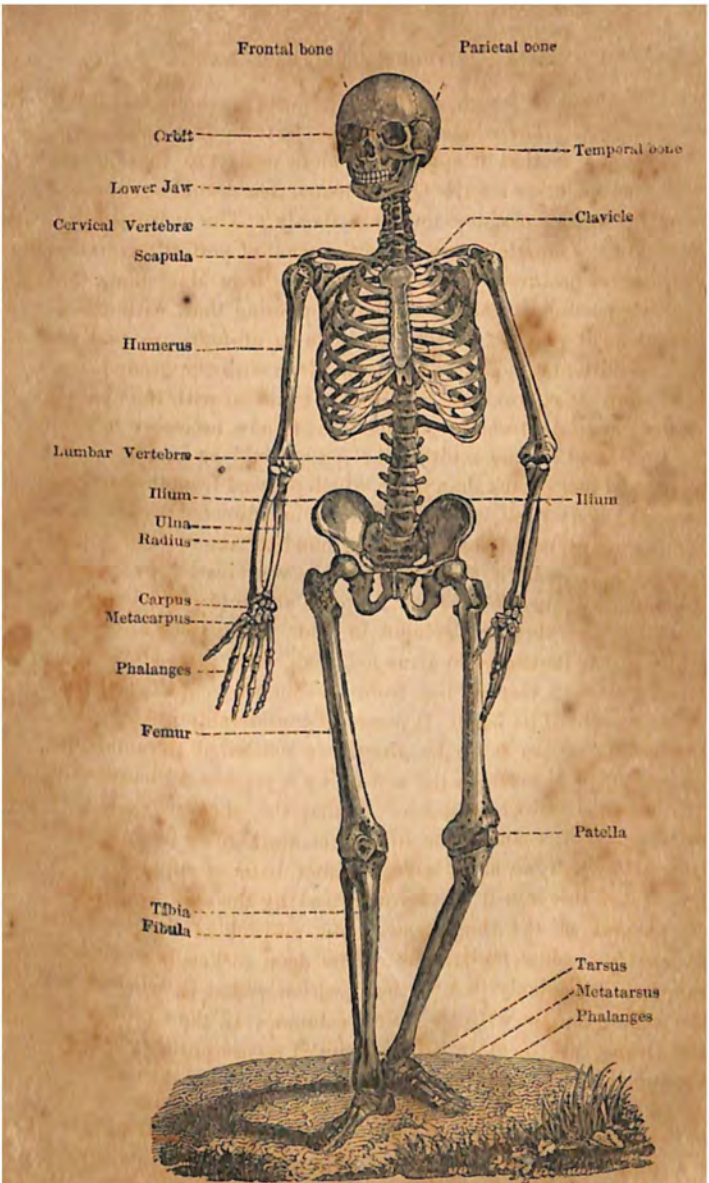

FIG. 67.—SKELETON OF MAN.

being drawn up (as it were) towards it. The formation of the knee-joint of Man, again, is such, that the whole weight of the body falls directly upon the head of the tibia, when the joint is in the firmest position in which it can be placed; and this is not the case even with the Apes, that approach nearest to him in form. The conformation of the foot of Man is, of itself, an indisputable evidence that the erect position is natural to him. It is proportionally larger, broader, and stronger, than the foot of any other Mammal, save the Kangaroo. The sole of the foot is concave, a sort of arch being formed by the bones and ligaments of which it is composed; and the weight of the body is thrown upon the summit of this arch, by the mode in which the ankle-joint is constructed. This is far from being the case with the semi-erect Apes; for they have the *os calcis*, or bone of the heel, small, straight, and more or less raised from the ground, which they touch, when standing erect, with the outer side of the foot only, so that they cannot stand at all firmly on their posterior limbs only. In animals more remote from Man, the os calcis is brought still more into the line of the tibia, (Fig. 51); and the foot being more lengthened and narrowed, the extremities of the toes alone come in contact with the ground. Hence Man is the only species of Mammal, that can stand upon one leg without other support; the Kangaroo, when using one of its hind legs to kick backwards at its pursuers, keeps itself erect on the other by means of its powerful tail.

132. The modification of the hind-foot of the Apes, which renders it unable to support the body firmly in the erect posture, is exactly that which gives it somewhat of the character of the *hand;* and consequently the hand of Man, in which this modification is still more completely effected, is still less adapted for the support of the body. The disproportion in length, between the anterior and posterior extremities, is another indication of the natural erectness of his posture. His legs are longer, relatively to the size of his trunk, than those of any other Mammal, except the Kangaroo; and his arms are shorter in proportion, than are those of the Apes that approach him most closely. For whilst his hands only reach the middle of the thighs, they

hang in the Chimpanzee on a level with the knees, and in the Orang they descend to the ankles; hence, when the bodies of the latter are thrown but a little forwards, their anterior extremities are ready to support them in this inclined position. Now it is evident that progression on all-fours would be rendered excessively inconvenient, in consequence of this disproportion. Either Man would be obliged to rest on his knees, with his thighs bent towards the trunk, and his legs and feet entirely useless; or he must elevate his trunk on the extremities of his toes, throwing his head downwards, and making the pelvis much higher than the shoulders. In either case, the only useful movement would be at the hip; and the knee and ankle joints would be of little or no use to him. Many other facts might be brought together, in addition to these, in support of the conclusion (which scarcely admits of being reasonably disputed), that the erect attitude, and biped progression, are natural to Man; and we must regard as in great degree fabulous all those histories of supposed wild men, who, it has been said, were found in woods, dumb, hairy, and crawling upon all-fours. The most elaborate investigation of the structure of the highest Apes, and the fullest acquaintance with their habits, concur in proving, that their movements are not easy or agile, unless they employ *all* their limbs for the support of their bodies.

133. Thus, then, although the order Bimana cannot be separated from the Quadrumana, by any single obvious point of structure, like that which characterises the Cetacea, Cheiroptera, Rodentia, or Ruminantia, it is really as far removed by the minuter, but not less important, modifications which have been detailed. A few others will now be noticed. With one exception (the fossil genus *Anoplotherium*, which is allied to the Tapir tribe) Man is distinguished from all other animals, by the equality in the length of all his teeth, and by their being closely ranged together in both jaws. Even the Apes have the canine teeth (especially in adult age) longer than the others; and an interval in the line of teeth in each side of the jaw, to receive the canines of the opposite jaw. The vertical position of the Human teeth, on which one of the most characteristic features

of the Human face,—the prominent chin,—depends, is also quite peculiar to him; and is intimately connected both with his erect attitude, and with the perfection of the hands, by which the food is divided and conveyed to the mouth. He has no occasion for that protrusion of the muzzle and lips, which, in animals that seize their food with the mouth only, is required to prevent the whole face from coming into contact with it.—The absence of any weapons of offence, and of any direct means of defence, are remarkable characteristics of Man, and distinguish him from other animals. On those, to whom Nature has denied weapons of attack, she has bestowed the means either of passive defence, of concealment, or of flight. Yet Man, by his superior reason, has not only been enabled to resist the attacks of other animals, but even to bring them under subjection to himself. His intellect can scarcely suggest the mechanism, which his hands cannot frame; and he has devised and constructed arms more powerful than those which any other creature wields, and defences so secure as to defy the assaults of all but his fellow men. As we might expect from his far higher intelligence, the brain of Man far exceeds that of the most elevated Quadrumana in size; and at least equally surpasses it in the complexity and high development of its internal parts, and in the depth and number of its convolutions.

134. Man cannot be regarded as distinguished from Mammalia, however, either by acuteness of sensibility, or by muscular power. His swiftness in running, and agility in leaping, are inferior to that of other animals of his size,—the full-grown Orang for example. The smallness of his face, compared with the remainder of the skull, shows that the portion of the nervous system distributed to the organs of sense is proportionally less developed in him than it is in most other animals; and we find that he is surpassed by many among them in the acuteness of his sensibility to light, sound, &c.; though he stands alone in the power of *comparing* his sensations, and of drawing conclusions from them. Moreover, although none of his senses are very acute in his natural state, they are all capable (as is also his swiftness of foot) of being much improved by practice, when

circumstances strongly call for their exercise. This power of adaptation to varieties in external conditions, which makes him to a great extent independent of them, is manifested in other features of his structure and economy. He is capable of sustaining the lowest, as well as the highest, extremes of atmospheric pressure; and in this respect he is strikingly contrasted with the Quadrumana, to all of which a warm climate is a necessary condition of their existence. Thus the Chimpanzee is restricted to the hottest parts of Africa, and the Orang Outan is only found in Borneo and Sumatra; they cannot be kept alive in temperate climates without the assistance of artificial heat; and even when this is afforded, they speedily become diseased and die. The diet of Man, as indicated alike by the conformation of his teeth and digestive apparatus, and by his natural tastes, is properly of a mixed kind; but he may support himself in health and strength on animal or vegetable food exclusively. It is partly to this capability of adaptation, that we are to attribute the various modifications of his form and external appearance, which are so remarkable in the various races that inhabit different parts of the globe. Some of these will be presently noticed.

135. The slow growth of Man, and the length of time during which he remains in a state of dependance upon his parents, are additional characters, by which he is distinguished from other animals, and which are closely connected with his ultimate superiority over them. He is unable to seek his own food during at least the three first years of his life; and he does not attain his full stature, until he is more than twenty years of age. This circumstance influences all the relations of parent and offspring; and is closely connected with that association of the members of the same family, and that continued affection amongst them, which we have no reason to regard as existing among any other animals. In proportion to his size, the duration of the life of Man is greater than that of other Mammalia. The greatest age of the Horse, for example, which is an animal of much superior bulk, is between thirty and forty years; that of the Orang, which, when full grown, surpasses Man in stature,

is about the same, so far as can be ascertained. The age to which the life of Man is ordinarily prolonged under favourable circumstances, may be stated as about seventy-five years; but it frequently surpasses a hundred,—and this among individuals of all nations.

136. It cannot be doubted, however, that the *mental* endowments of Man, and the habits of life which result from them, distinguish him much more completely from the lower animals, than do the peculiarities of his bodily structure and actions. In the highest among brutes, the mere instinctive propensities are the frequent springs of action (ANIM. PHYSIOL. Chap. XIV.); and though the intelligence and will may operate to a certain extent, the character never rises beyond that of the child. In fact, the correspondence between the mental faculties of the Chimpanzee, and those of the Human infant of between two and three years old, is very close. In adult Man, however, the instinctive propensities only manifest themselves strongly, when the intellect is undeveloped; and nearly all his actions are performed under the immediate guidance of his intelligent will. From the intelligence of Man results his power of improvement; and this, acting from generation to generation, is the cause of the comforts now enjoyed by civilized races, and of the means which they possess of still further civilization. In the mode in which these are attained, we observe a remarkable difference between the character of Man, and that of the lower animals. The arts of which *they* are capable, are limited and peculiar to each species; and there seems to be no *general* power of adapting these to any great variety of purposes, or of profiting by the experience of others. Where a particular adaptation of means to ends, of actions to circumstances, is made by an individual (as is frequently the case where some amount of intelligence or rationality exists), the rest do not seem to profit by it (ANIM. PHYSIOL. § 695); so that there is no proof of any species or race, among the lower animals, ever making an advance towards an improvement or alteration in its condition. It has been already pointed out (§ 110), that modifications in structure and instincts may be induced by circumstances in some of the most improvable species; but, in

order that these may be hereditarily transmitted, they must not be foreign to their natural character. This may be accomplished in a still higher degree, in regard to Man. Under the influence of Education, corporeal and mental, continued through successive generations, the capabilities of his whole nature, and especially those of his brain, are called out; so that the general character of the race is greatly improved. On the other hand, under the influence of a degraded condition, there is an equally certain falling-back; and the longer this operates, the more difficulty will there be in again elevating the race. Hence, to bring up the New Holland Savage, or the African Bushman, to the level of the European, would probably require centuries of civilization.

137. One of the most important aids to the use and development of the Human mind, is the power of producing articulate sounds, or *language*; of which, as far as we know, Man is the only animal in possession. There is no doubt, that in many other species, certain powers of communication exist; but these are probably very limited, and of a kind very different from a *verbal* language,—more resembling, in fact, the language of *signs*. How little this can convey, in comparison with verbal language, we can only realize when we attempt to hold converse with a foreigner whose tongue we do not understand, or with one of those unfortunate persons, in whom there is deficiency of the powers of hearing and speech. In fact, such language can only apply to *things*; and cannot express those general and abstract ideas, which form a large part of our own current of thought. For example, we could not convey by signs the *qualities* of hardness or softness, smoothness or roughness, without referring to some object which exhibits them. And all we know of the mental habits of the lower animals leads to the belief, that in such general ideas they are completely deficient. Above all, it would seem that the mind of Man is distinguished from theirs by the faculty of conceiving of a Superior Being, enjoying a purely spiritual existence, Omnipotent, Omniscient, and Omnipresent (ANIM. PHYSIOL. § 721, 722).

138. It is well known that there is a considerable variety of races of men; differing from each other, not only in language,

habits, degree of civilization, &c.; but in the conformation of their bodies, the colours of the surface, the degree in which it is covered with hair, &c. And it comes to be a question of great scientific interest, as well as one that considerably affects the mode in which we view and treat the races that differ from our own,—whether they are all of one species, that is, whether they may have all descended from a common stock,—or whether they are to be regarded as distinct species, having had an originally distinct parentage. It has been a favourite idea with some of those, who wished to excuse the horrors of slavery or the extirpation of savage tribes, that races thus treated might be considered as inferior species, and as legitimately placed under our dominion; but this doctrine, which has had its origin in the desire to justify as expedient what could not be defended as morally right, finds no support from scientific inquiries conducted in an enlarged spirit. For although it would be easy to select from amongst different races, such as the European, the Guinea-coast Negro, the Kafir, the Tartar, the Malay, the New-Holland, and the American Indian, a set of forms, which, when placed side by side, should present very strongly-marked distinctions,—yet it would be found that, among all these races, examples would occasionally present themselves, in which these distinctions would be much less obvious. Thus, among the inhabitants of our own country, we may not unfrequently meet with individuals of pure European descent, who have the receding forehead, the woolly hair, the thick lips, and the projecting muzzle of the Negro; and who want little else than a dark colour in the skin, to have all the chief peculiarities of that race. On the other hand, among some of the Negro races, examples are not unfrequently to be seen, in which the general form of the head and body is that of the European; the chief difference being in colour. That colour alone cannot be at all relied upon as a distinction, is proved by the fact, that a large number of *pigment-cells* exists in the skin of *all* the races of Man; and that the nature of their secretion, and the consequent hue of the skin, depends greatly upon the degree in which the surface is exposed to light and heat (ANIM. PHYSIOL. § 492). Moreover, amongst

the various races that unquestionably belong to a common stock, we find varieties of colour almost as great as those which exist between the so-called distinct species. Thus, the Moors of Northern Africa, the Hindoos of India, the fair-haired Saxons, and the sun-burnt inhabitants of Southern Europe, may be all referred with certainty to a common parentage; the differences between them being for the most part only "skin-deep," and the relationship between them being shown by affinities in language, customs, &c., as well as by general conformity in the structure of their bodies. The same may be said of the various races inhabiting Africa; which, with the exception of those of Moorish origin, undoubtedly belong to one family; yet they differ most widely from each other in colour, and in many points of general conformation. Some of them, as the Kafirs, and some nations in the interior of that vast continent, appear to be elevated above the ordinary Negro type; and present much resemblance to the European stock: whilst others, as the Negroes of the Guinea Coast, with whom *we* are most familiar, are evidently degraded from it. In fact, there is fully as much difference between these, as there is between those of the Negro and European races, which most nearly resemble each other.

139. Such considerations alone would induce us to hesitate much, before giving the character of distinct species to these various races; more especially, as we find that the differences they present are such as exist among the breeds of domestic animals; which we have every reason to refer to a common origin (§ 13 and 107). There is not so much difference, for example, between the European and the Negro, as there is between the Mastiff and the Greyhound. And, as before remarked, the conformation of the human body is such, that it easily adapts itself to variations in its external conditions, and must therefore change in accordance with them; so that we should be justified in expecting at least as much difference among the races of Men, whose circumstances in regard to climate, food, nature of the country, &c., are of an opposite character, as among the breeds of domesticated animals. All argument from analogy, therefore, is in favour of this view; and there are some additional grounds

for the belief in the common origin of the human family, which seem to give it the rank of a scientific fact.—Thus there is a complete agreement amongst all races of Man, however different they may be in aspect and habits, as to the manner in which the most important functions of the body are performed, the periods at which they take place, the average duration of life, &c.; or, at least, whatever variations may present themselves in these respects between *different races*, they are not greater than those which are found among *individuals of the same race*, under different circumstances in regard to climate, food, &c. If the test which has been laid down for the distinction of species (§ 14, *note*) be really valid, its application to this question removes all doubt; for it is well known, that not only does a mixture of different races produce offspring, but the individuals of the mixed race thus originated are fertile with each other, so that the mixed race is continued,—which is not the case with *hybrid* races, that originate in a *crossing* of different species. Moreover, the mixed race is generally equal in personal qualifications, and sometimes even superior, to either of the parent stocks; and, instead of having a tendency to degenerate and die out, its fertility is usually greater, so that it rapidly increases. It is probable that, in many parts of the world,—such as South America and Hindostan, the races that have been produced by the intermixture of Europeans with the natives of those countries, will ultimately attain the predominance. Now, even if it should ever occur in Animals, as it sometimes does in Plants (VEGET. PHYSIOL. § 454), that a hybrid race, produced between distinct species, should be able to keep itself up for a few generations, it would be safe to affirm that it would ultimately cease to exist,—either being lost altogether, or merging into one of the parent races, by intermixture with it.—Consequently it is evident, from this test, that we are justified in regarding the different races of Man, not as distinct species, but as *varieties*, which have arisen in course of time, and under the influence of peculiar circumstances, in the same manner as the breeds of the domesticated races (§ 107—114).

140. The same conclusion has been arrived at from a com-

parison of the *mental* characters of the several races; for it has been shown that, however various the degree in which they have been respectively developed, the same *elements* exist in all; and that individuals of even the most degraded races have exhibited, under the influence of education, the same exalted powers and elevated tendencies, which many of those in whom they are most fully developed, are accustomed to regard as peculiar to themselves.

141. Notwithstanding that we have determined to refer all the existing races of Men to one common origin, yet it would appear that the chief varieties of form must have presented themselves at a very early period. Thus, the hieroglyphic records of Egypt afford testimony, of an older date than that to which any written language carries us back, as to the existence of black and red races at those periods; and the traditions and remains of the Chinese and American nations, seem to carry back their existence as distinct stocks, to an epoch almost equally remote. Although almost every nation has its distinctive peculiarities at the present time, yet it is easy to see that there is a comparatively small number of prevailing *types* of form, to which they may be referred,—as the different forms of the domesticated animals are referred to certain breeds. Some have thought that these might be reduced to *three;* and have supposed that they derived their origin from the three sons of Noah, respectively. The more usual division has been into *five;* the Caucasian, Mongolian, African or Negro, Malay, and American. From a most profound and extensive comparison, however, of their physical characters, languages, and customs, Dr. Prichard sees reason to arrange them under *seven* classes. These are:—1. Those nations (commonly termed Caucasian) which, in the form of their skulls and other physical characters resemble Europeans; this division includes all the European nations, with the exception of the Lapplanders and Finnish races, inhabiting the north-eastern portion; and also comprehends several nations in the north of Africa, and in the west and south of Asia: of this race, the Greeks seem to afford the most perfect model.—2. Those nations (commonly termed Mongolian) which bear a resemblance in the figure of

their skulls, and in their general conformation, to the Kalmucks, Mongoles, and Chinese; these occupy the north and east of Asia; and the Laplanders and Finnish races of Europe, and the Esquimaux of America, seem to belong to the same class.—3. The third class includes the native American races (excluding the Esquimaux), which bear a very strong resemblance to one another, both in physical and moral characters, notwithstanding the immense extent of country over which they are distributed. Here, as in the nations of the first division, we find great difference in regard to colour; the temperate regions being inhabited by white races of a florid complexion; whilst the tropical portions of that vast continent are tenanted by tribes of very dark or even black hue.—4. To the fourth class belong only the Hottentot and Bushman races, which inhabit the south of Africa, and differ so strongly from the other nations of that continent, as to require being placed together in a distinct group.—5. The Negro races, including the inhabitants of the African continent, between the parts occupied by the Moorish and other nations of the first class in the north, and those belonging to the Hottentots and Bushmen.—6. ThePapuas, or woolly-haired races, which are diffused through New Guinea and the islands of the Malayan Archipelago.—7. The Alfourou and Australian races, which exhibit the characters of the human species in its most degraded form. These are found in New Holland, and in the interior of some of the larger islands of the Malayan Archipelago.

142. In regard to the evidence which Geology affords, as to the distribution of Man over the globe at former periods of its existence, it is sufficient to observe that it affords a most striking confirmation to the Scriptural statement on the subject; for no fossil remains of Man have ever been found, except in deposits which we have good reason for affirming to be of very recent date, or to be still going on; and wherever the remains of other animals are associated with his, they belong to species at present existing. Thus, Geology and Zoology, so far from being opposed to Revelation, confirm it in these very important particulars;—1. That Man has not been a perpetual inhabitant of this globe, but that his introduction into it took place not many thousand

years since, probably at the same time with the creation of a large number of other animals; and that no very great change has since been made in its surface.—2. That, notwithstanding the diversities among the races now existing, they *may have* all originated, and probably *did* originate, from one common stock.

ORDER II.—QUADRUMANA.

143. The characters upon which this order is founded have been already explained (§ 120); and the points in which it chiefly differs from the preceding, have been adverted to under the last head. It remains to notice some other general characters, however; and to point out how these become modified in the different subdivisions of the order.—In the first place, as already remarked, the Quadrumana are not the only animals possessing opposable thumbs on the feet as well as the hands (§ 126); nor do we find this character to be universally presented by them. In one large division of the order, indeed, we find that the thumbs are possessed by only one pair of the members; but this is the *hinder* pair, which is thus converted into hands; whilst the *front* pair of extremities, not being possessed of thumbs, lose the distinctive character of *hands*. It would be a more correct designation of the whole group, therefore, to term it *Pedimana*, or *foot-handed*,—implying that the posterior extremity is converted into a hand, which is a *constant* character of the order,—rather than *Quadrumana*, or *four-handed*, which does not correctly apply to a large portion of it.—We must connect with this description, in order to distinguish these animals from other four-handed Mammals, the characters derived from their teeth; for in them alone do we find all the three kinds present. Yet even this is not an invariable character; for there are certain aberrant forms, which have a dentition that leads us towards the Rodentia, and in which only two kinds of teeth are present. But these so closely resemble the Quadrumana in their general characters, that there can be little doubt of their real affinity to them.

144. There are very marked differences among the different tribes of this order, as to the degree in which they approach Man in their general conformation; some of them bearing a strong resemblance to him in structure, aspect, and gait; whilst others are but little removed from the type of the ordinary Mammals. The difference between the young and adult form is very considerable, especially as regards the shape of the head; this is seen in a very striking manner in the Orang Outan; of which the young specimen has been placed at the head of the order, being supposed to form the nearest approach to Man: whilst the old one, supposed to be altogether a different animal, has been degraded below the level of the Baboons, on account of the great diminution in its facial angle.

145. There are also considerable differences among them, as to food and habits. As a general rule, they may be said to be *omnivorous*,—that is, disposed to eat anything, or to subsist on a mixed diet. The Apes, Monkeys, and Baboons, search after and devour the eggs of birds, locusts, and even small lizards, with great diligence and appetite; and in confinement they devour animal flesh with great delight. But their natural tastes lead them to mingle their animal prey with fruits or other succulent vegetable substances; and if they are kept from these when in confinement, they become unhealthy.—In regard to their habits of life, too, there is great variety. Some of them live solitarily, or in pairs; others, and these the larger proportion, in societies. Some go in search of their food by day; but the greater proportion are nocturnal in their activity. For the most part, they inhabit trees; but some species live on the ground; and others among rocky and almost inaccessible heights.

146. The order may be well subdivided into three great families, which are remarkably limited in their geographical distribution. The first is that of the SIMIADÆ, which includes the Apes, Monkeys, and Baboons of the Old World: these have always the same number of teeth as Man, and their nostrils are placed close together at the front of the nose. Hence they are called *Catarrhinæ* by many Zoologists. In the CEBIDÆ or

Monkeys of the New World, there is usually a sixth molar in either side of each jaw, so that the total number of teeth is 36, and the nostrils are placed wide apart at the sides of a broad, flat nose, whence these Monkeys are denominated *Platyrrhinæ*. In the third family, that of the LEMURIDÆ, which is almost confined to Madagascar, the teeth are less regular in their number, and the animals approach more closely to the lower Mammals in their structure. In the majority all the extremities are provided with thumbs, and the nail of the first finger in the hinder hands is converted into a claw.

147. The popular division of the family SIMIADÆ into Apes, Monkeys, and Baboons, is more scientifically correct than such arrangements usually are. The *Apes* are distinguished by having neither tails nor cheek-pouches; and by the partial or entire absence of the *callosities*,—or hard spaces, destitute of hair,—which are found on the buttocks of the other two groups. They inhabit the woods, and walk principally on their hinder extremities; steadying and directing their motions with their long arms, which they use also to swing themselves from branch to branch. The *Monkeys* have cheek-pouches, callosities, and long tails. They, too, live among the woods; but they usually walk on all-fours, using their long tails chiefly for the purpose of guiding and balancing themselves, during their rapid and agile movements. The *Baboons* also have cheek-pouches and callosities, by which they are distinguished from the Apes; whilst they are known from the Monkeys by the shortness of their tails, which never possess any muscular power, and cannot give any efficient assistance in the movements of the animals. The Baboons live, for the most part, among rocks and mountains, being seldom or never found in the forests; and they walk on all-fours. These three tribes further differ in their mental characters. The Apes possess great intelligence, patience, courage, and docility; and, when taken young, may be made to receive a considerable degree of education. Their actions are grave, circumspect, and deliberate; they are seldom moved to violent passion, though occasionally peevish and fretful when teazed or thwarted; and they easily give their confidence to

those who treat them kindly, and seem to study to comprehend the directions given to them. On the other hand, the Monkeys are characterized by cunning, petulance, caprice, and mischievous curiosity; their actions are far more rapid than those of most of the Apes, and are destitute of that gravity which marks the latter; they are far from being as intelligent and educable, and display much less attachment to individuals. The Baboons are much less amiable than either, and exhibit a sullen ferocity, together with a comparative absence of intelligence, which prevents them from receiving any large measure of education, or from being even properly reduced to subjection.

148. The *Apes* are principally confined to the Peninsula of Malacca, and the great islands of the Indian Ocean. One species, the *Chimpanzee*, is a well-known inhabitant of Western Africa; and this is the one which presents the nearest approach to Man of the entire group. The structure of its lower extremities enables it to walk erect with more firmness than most of the Apes, but nevertheless its whole organization indicates arboreal habits. It feeds upon fruits and nuts, lives in small societies, and usually constructs a sort of nest amongst the branches of large trees. This has given rise to the old stories of Apes that built themselves huts and lived in regular villages. When young, the Chimpanzee is very tractable. But no full-grown specimen has ever been brought alive to this country; and it is only within the last few years, that even the dead body of an adult has been scientifically examined. The height of a well-developed individual seems to be above four feet; but the young specimens that have been exhibited in this country have not

Fig. 68.—Chimpanzee.

much exceeded half that stature. A second species of Chimpanzee has lately been discovered in Western Africa, and described under the name of the *Gorilla*. It is said to be between six and seven feet in height when adult.—The *Orangs*, of which two species exist, are natives of Borneo and Sumatra. They exceed the Chimpanzee in height, and are said even to surpass the ordinary stature of Man; but they depart much more widely from his general conformation, being evidently still more adapted for arboreal habits,—that is, for living amongst trees, than the African Chimpanzees. When we look at the position of the legs, we observe that, instead of being in the same straight line as the thighs, they are bowed outwards at the knees, so that the soles are turned inwards and opposed to one another. This accounts for the great difficulty which the Orang Outan has been observed to experience, in preserving the upright posture, or walking upon the surface of the earth; as well as for the amazing facility, with which it has been observed to climb trees, and make its way through forests. In these last actions, it is greatly assisted by the anterior members, the great length of which enables them to bear a part in the support of the body, when it is but slightly thrown forwards. The Orangs which have been captured when young, and put under the training of Man, show great docility, gentleness, and intellectual capacity; but in no instance have their lives been prolonged through their second dentition, at which period a great change seems to take place in their characters. They then display great unsociability and gloominess of temper; but when irritated, manifest a degree of activity and force, together with even some ferocity of temper, which would scarcely have been expected from them. They are said to form a sort of rude huts among the trees in which they reside, by intertwining their branches; and in these they spend most of their time, seldom moving abroad, except when urged by the calls of appetite. They feed entirely on fruits, and are never known to eat flesh or even eggs, in their natural state; but in confinement, they may be readily taught to relish animal food. They seem to lead a solitary life; never more than two or three being found in each other's neighbourhood.

149. The *Gibbons* (forming the genus *Hylobates*) differ from the preceding Apes, chiefly in the slenderness of their form, and in the great length of their arms, which reach nearly to the ankle-joints when the animal is standing erect; hence they are commonly known as long-armed Apes. The hands and feet are still more adapted for climbing than are those of the Orang; and the feet, which are very long, have their soles turned so much inwards, as to afford no firm support in the erect posture. They are distributed through Java, Borneo, Sumatra, Malacca, and Siam; where they tenant the forest branches, among which they display the most astonishing activity. They sweep from branch to branch with arrow-like velocity; their mode is to suspend themselves by their long arms, and by an energetic muscular movement to launch themselves onwards, aiming at distant branches, which they seize with the most wonderful precision; and often, without any pause, and almost without any perceptible effort, they swing themselves forwards in a similar manner to another equally distant branch. The most remarkable known species, in this respect, is the *Hylobates agilis*, or Agile Gibbon, better known by its native appellation of *Ungka-puti;* a living specimen of which was recently exhibited in this country. This animal was about three feet in height; but the space between the points of the fingers, when the arms were extended, was not less than six feet,—or as much as that of a tall Man. When allowed to move freely in a large room, it would clear, without any effort, distances of 18 or 20 feet; bounding round and round, with no other support, than that which it derived from the projections at which it caught, as it were momentarily, in passing. The ease with which this feat was accomplished, renders the statement of those who have observed it in its native haunts quite credible,—that it can thus clear a space of forty feet at one swing. This animal is further remarkable for a very curious song, or call-note, which is uttered ever and anon during its most active movements, but especially in the morning. It is timid and gentle in its character, and easily becomes attached; but it does not associate much with others of its own species. The *Hylobates*

syndactylus,* or *Siamang* (Fig. 69), is another species of Gibbon, of greater size, and more robust proportions, also inhabiting Sumatra. It is remarkable for possessing a pouch, or sac, in its throat, which is connected with the larynx, and seems to have some influence on the voice; this is described as a hollow barking sound. The Siamang is a bold and powerful animal; but is easily domesticated, and is then gentle in its manners, forming strong attachments. In their native haunts they associate together in troops, under the direction of a leader; and they utter their cries simultaneously in the morning and evening, making a most discordant noise. Their movements are not nearly so active as those of the species just named; but their vigilance is great, and their hearing seems remarkably acute; so that they are enabled to make a timely retreat from danger. The specific name of this animal is derived from the adhesion of the first and second fingers, as far as the last joint which bears the nail.

FIG. 69.—SIAMANG.

—Several other species of Gibbon, of which less is known, inhabit the same portion of the globe.

150. The *Monkeys* are distinguished, as already stated, by possessing cheek-pouches, callosities on the buttocks, and long tails; and all these peculiarities of structure are intimately connected with their habits. The cheek-pouches enable them to stow away and carry off large quantities of nuts and fruits for future consumption; and these stores they usually obtain by periodical excursions from the forests in which they reside, to the more open and fertile spaces, and especially to cultivated

* Meaning "united-fingered."

tracts, if such should be in their neighbourhood. The callosities enable them to take their repose in a sitting posture, and thus render them more independent of a convenient place of rest than are most of the Apes. We find some approach to them, however, in the Gibbons; whose habits more resemble those of the Monkeys, than do those of the higher Apes. And the tail serves to them very much the same purpose as the pole to the rope-dancer, acting as a balance to ensure their equilibrium, when their hands are otherwise occupied, and guiding them like a rudder in their leaps through the air. In accordance with the principles so often alluded to, we do not find that the characters which distinguish the group of Monkeys are possessed by all the members of it. Thus, in the genus *Semnopithecus*, we find the cheek-pouches almost completely absent; but this deficiency is compensated by a very remarkable development of the stomach, which has several distinct pouches, or sacs, branching off as it were from its principal cavity (Fig. 70). The thumb, too, is comparatively short

Fig. 70.—The Stomach of Semnopithecus.

and imperfect in these animals; and in the genus *Colobus* it is entirely absent.

151. The first genus of Monkeys, that of *Semnopithecus*, bears many points of resemblance to the Gibbons, besides the absence of cheek-pouches in the one, and the presence of rudi-

mentary callosities in the other; and through these two genera, the tribes of Apes and Monkeys may be regarded as pretty closely connected. They are readily distinguished, however, by the long, slender, but powerfully muscular tail, of which the *Semnopithecus* is possessed. The animals included in this genus are commonly termed "Slow Monkeys," from their gravity of habit, and the absence of the restlessness usually seen in the tribe. But their slowness is rather that of disposition than of action; for, when roused, they show themselves capable of the most surprising exertions, and astonish the spectator by the rapidity, variety, and precision of their movements. The species represented in the accompanying figure is very abundant in some parts of

Fig. 71.—Entellus, or Hoonuman.

India, and receives divine honours from the natives, by whom it is termed Hoonuman. "Splendid and costly temples are dedicated to these animals; hospitals are built for their reception when sick or wounded; large fortunes are bequeathed for their support; and the laws of the land, which compound for the murder of a man by a trifling fine, affix the punishment of death to

the slaughter of a Monkey. Thus cherished and protected, the Entellus abounds over almost every part of India, enters the houses and gardens of the natives at will, and plunders them of fruit and eatables without molestation. The visit is even considered an honour; and the Indian peasant would consider it an act of the greatest sacrilege to disturb or drive them away." They generally take up their residence in the groves which the natives plant round their villages; and the celebrated banyan-tree, named Cubbeer-bur, which forms a grove in itself (VEGET. PHYSIOL. § 152), is the residence of a numerous colony of them. They are often allowed to occupy the roofs of the houses; and may be not unfrequently seen perched with much gravity at the open verandas, observing the passing crowd. To this genus, also, belong the *Kahau*, or Proboscis Monkey (*Semnopithecus larvatus*), a native of Borneo and Cochin-China, which is remarkable for the extraordinary development of its nose; and the *Douc*, or Cochin-China Monkey (*S. nemæus*), which is distinguished by the singular variety and brilliancy of its colours,—giving it an appearance as if it were clothed with a suit of garments of different materials. There are other species of Semnopithecus, which also inhabit India and the Malay Archipelago; and it is curious to notice, that all the Monkeys of these regions should be of a kind that most nearly resembles the Apes, which are all but exclusively confined to it.

152. The continent of Africa, however, may be regarded as the head-quarters of the Monkey tribe; for no other portion of the earth swarms with these animals to such a degree as its western coasts,—their number being due, not only to the multiplication of individuals, but to the great variety of species which are spread over the face of the country. Between twenty and thirty different kinds are known to inhabit the west coast alone; and it is probable that, if we were equally acquainted with the interior and eastern coast, we should be able to reckon up at least a hundred. It is believed that each of the different species is restricted to a small extent of country; and it is said that they live in large troops, each of which has its own domain, violently

resisting any intrusion upon it. The African Monkeys are mostly of small size; and are remarkable for the agreeable variety and intermixture of their colours, and for their playful, lively dispositions. They are classed under two genera, *Colobus* and *Cercopithecus*. Of the genus *Colobus* little is at present known, no specimens having been brought alive to Europe; and, of several of its species, only mutilated skins having been examined. The reason of this is partly that the skins are much valued by the negroes on account of their long, soft, silky hair; and that the hunters will not be at the trouble of skinning and preparing the head and limbs, so long as the fur of the body is the only part of value to them. It is certain, however, that numerous species exist, which may be all readily distinguished from those of the *Cercopithecus* by this simple and apparently trifling character,—that the hairs of the former are of the same colour throughout, although different hairs have different hues,—whilst the hairs of the latter are marked by rings of various shades. Thus a very small piece of the skin will enable us to separate the two genera; but the character which essentially distinguishes them, is the absence of the thumb from the hands of the *Colobus*, and its presence in the *Cercopithecus*. It has been stated that in the *Semnopithecus*, this organ is but slightly developed; still, however, it can be opposed to the fingers. In some species of the *Colobus* a rudiment of it is perceptible; but this never rises above the skin, and is totally destitute of motion: and in what may be regarded as the *typical* species, it is entirely absent. This deficiency is in some degree compensated by the great length of the other fingers. The habits of the *Colobi* resemble those of their Asiatic representatives the *Semnopitheci*, and their stomachs are larger than those of ordinary Monkeys, and exhibit the same complication of structure as those of their eastern relatives, although they possess fully-developed cheek-pouches.

153. To the genus *Cercopithecus* belong nearly all the Monkeys of the Old World, with which we are most familiar; and it may probably be regarded as the *typical* genus of the tribe,—possessing, as it does, in a pre-eminent degree, all the characters which

distinguish it. These Monkeys have cheek-pouches, callosities, well-developed thumbs on their hands, and long tails; and they are further known by the *annulated* or ringed character of their fur, which gives them a speckled appearance. They are slender in their structure, and light and agile in their movements; and their characters display vivacity, impetuosity, and restlessness, with occasional caprice and petulance. They are a pre-eminently sylvan race, never abandoning the forests, and living chiefly upon wild fruits and the seeds and buds of trees, with an occasional intermixture of insects and birds' eggs. The true *Cercopitheci* are confined to Africa; but there are a few species of Monkeys in Asia (commonly included among the *Macaques*), which approach the Baboons in their general characters, but which are probably to be united with this genus, as they agree in its essential characters, except in having a shorter tail; and by these we should make a natural transition to the next tribe.

154. The *Baboons* are distinguished from the other Quadrumana, not only by the peculiar distinctive characters which have been already mentioned (§ 147); but also by certain obvious, though less easily defined, characters. The body is much more massive, and the strength is increased in even greater proportion. The projection of the muzzle, at the end of which the nostrils are situated, gives to the face much more of the aspect of the Carnivora; and they move much more exclusively upon all-fours, than do any of the other SIMIADÆ. Their temper is gloomy and sullen; and they exhibit a considerable degree of ferocity when they are attacked, together with a large amount of malice and revengeful feeling when they are offended. These characters, however, are not exhibited in an equal degree by the two groups of which the tribe consists,—the *Macaci* and *Cynocephali*; for in the animals belonging to the former group, they are softened down, as it were, so that the line of separation between them and the Monkeys is by no means distinct; whilst in those of the latter, they are manifested in their highest degree. It is an interesting circumstance, that these two groups should be restricted to different quarters of the globe,—the *Macaci* being

almost exclusively Asiatic, and the *Cynocephali* exclusively African. They are not, for the most part, inhabitants of the forests, but rather of mountainous or rocky districts; and their food consists at least as much of animal as of vegetable substances.

155. The genus *Macacus* is spread over India and the Indian Archipelago; and is distinguished from those species of *Cercopitheci*, which have a similar geographical distribution, by the comparative shortness of the tail. There is a difference in this respect amongst its several species; some of them having tails several inches long, whilst in others this organ is a mere rudiment. But even where it is longest, it is not muscular; and it hangs down vertically as in ordinary Mammals, instead of being extended horizontally as it is in the Monkeys, who use it as an instrument of progression. In their young state, they are docile and active, possessing the playfulness of the Monkeys, with more intelligence; but as

Fig. 72.—Wanderoo.

they advance in age, they exhibit more of the sullen ferocity of the true Baboon character, completely losing their docility, if not their intelligence, and becoming alike insensible to blows or caresses. As an example of this genus we may notice the *Papio silenus*, or *Wanderoo*, which is a native of Malabar and Ceylon,

and is remarkable for its look of wisdom and importance, and for the gravity of its demeanour. The peculiarity of its aspect is chiefly due to a kind of mane of greyish-dun hair, which surrounds the face and neck, and bears some resemblance to a judge's wig.—Although most abundant in Asia, the genus Papio extends also along Northern Africa; and one species, the *Papio inuus*, or *Magot*, is commonly known as the Barbary Ape. This is remarkable as being the only Quadrumanous animal, which is at present a regular inhabitant of Europe. A large number tenant the Rock of Gibraltar; where they seem to thrive as well as on the opposite side of the strait. This species was well known to the ancients, by whom many fables are related respecting it; and it has been the "showman's ape" from time immemorial. To the appellation Ape it would seem to be entitled by the complete absence of the tail; but the presence of callosities and cheek-pouches, independently of its general conformation, prove its real position to be among the Baboons. When young, it may be educated in some degree; but as it advances towards maturity, it becomes morose, sullen, and mischievous in confinement. In its native haunts, however, it is represented as social, active, and courageous; and is particularly distinguished by its attachment to its young.

156. The genus *Cynocephalus* (dog-headed) receives its name from the strong resemblance which the face, and especially the muzzle, bear to that of the dog. The Baboons of this group are of large stature and prodigious force, never voluntarily assuming the erect attitude, and dwelling amongst craggy rocks and precipices, which they climb with great agility. Their diet partly consists of bulbous roots, berries, and grain; and partly of eggs, insects, and scorpions,—which last they devour with great dexterity, nipping off the sting with an action so rapid, as to prevent their being wounded by it. They are morose and daring in their temper; and their physical power renders them very formidable opponents. They congregate in troops, and are bold and skilful in their predatory excursions, maintaining their ground even against large parties of men. The accompanying figure represents the *Cynocephalus hamadryas*, or Grey Baboon, which is a native

of the Eastern coast of Africa, being found also along the opposite shores of Arabia. It is the only species of this genus which

Fig. 73.—Grey Baboon.

extends beyond the African continent; and grows to the size of a large pointer; measuring upwards of four feet in height when standing erect, and two feet and a half when in a sitting posture. The head, neck, and front of the body are covered with long shaggy hair; whilst that on the hips, thighs, and legs, is short; and, when contrasted with the former, has the appearance of having been clipped, so that the whole animal somewhat resembles a shaved French poodle.—The largest and most ferocious of all the Baboons is the *C. maimon*, or *Mandrill;* the ordinary height of which, when standing erect, is nearly the same as that of a man; and the head of which presents a strange mixture of colours, as if it were painted for show. The body is thick and extremely robust, the limbs short and powerful,—the head is large and almost deprived of forehead, the eyebrows remarkably prominent, the eyes small and deeply sunk in the head, the cheek-bones swollen to an enormous size, and forming projections of the size of a man's fist on each side of the nose, which are

marked with numerous prominent ribs of light blue, scarlet, and deep purple;—the hair is a light olive-brown above, and a silvery grey beneath; but of a deep orange colour beneath the chin, where it forms a small pointed beard; and directed upwards above the forehead and temples, so as to meet in a point on the crown, thus giving the head a triangular appearance;—the ears, palms, and soles are violet-black;—and the callosities are of a bright scarlet. In its native wilds, the Mandrill associates in large troops which are more than a match for the fiercest beast of prey; and they often make excursions into villages and cultivated fields, which they plunder with impunity. Their voice is deep and guttural, consisting of hoarse abrupt tones, which indicate fury and malice; and in captivity they are very furious and violent, killing any animals that come within their reach, when their passions are excited, and being more than a match for the strongest unarmed man. This formidable animal is a native of the Western Coast of Africa; as is also another species, the *Drill*, which is rather smaller in stature than the Mandrill, and less ferocious. The face is black; but the beard is orange-coloured. The accompanying delineation of the head shows the marked approach in its form to that of the Carnivorous Mammals.

Fig. 74.—Head of the Drill.

157. In concluding this account of the Simiadæ, we may stop to notice some peculiarities in the geographical distribution of the family, which are of much interest to the philosophic naturalist. It is evident that the south-east of Asia may be regarded as the head-quarters of the *Ape* tribe; since we find but two species, the Chimpanzee and the Gorilla, beyond its limits. Neither the Monkeys nor the Baboons which inhabit that region present the full development of their respective characters; for the Semno-

pitheci want the cheek-pouches of the typical Monkeys; whilst the Macaques are equally far from possessing the stoutness of build and the muscular energy, which characterise the true Baboons.—On the other hand, in Africa, where we find only two species of Ape, the Monkeys and Baboons are most abundant, and their characters most fully displayed. The only African genus that is deficient in the peculiarities of its tribe, is that of *Colobus*, which seems to *represent* in Africa the Semnopithecus of Asia; and this bears a very small proportion, in the number of its species, to the typical Monkeys and Baboons.—Lastly, it is curious to observe that, whilst *all* the African Simiadæ, save the Chimpanzee, possess cheek-pouches, these do not exist in any of the Asiatic species, except a few Cercopitheci, and the Macaques.

158. FAMILY CEBIDÆ. This family includes all the American Monkeys; which differ from those of the Old World in several particulars, besides those already stated (§ 146). The thumb of the fore-hands is never opposable to the fingers, and is very frequently wanting. The callosities and cheek-pouches are altogether absent. The tail is usually of considerable length, never wanting, and often prehensile (that is, capable of laying hold of branches &c.,) especially in the species that are destitute of thumbs. In all but the Marmozets, there is a third bicuspid molar on each side; making the molars in all $\frac{6-6}{6-6}$, instead of $\frac{5-5}{5-5}$; and bringing the total number of teeth to 36, instead of 32, —as in Man and the Simiadæ. A very obvious and simple character, which is constant in each group, but the connection of which with their general organisation seems by no means evident, serves to distinguish the Cebidæ from the Simiadæ;—the apertures of the nostrils in the former are directed laterally, or outwards; whilst in the latter they are directed downwards or forwards, according to the position of the head.—The Cebidæ are exclusively confined to the warmer regions of the New World; so that, although the species are numerous, their extent of territory is far more limited than that occupied by the Old World Monkeys. They inhabit the northern portion of South America, from the Caribbean Sea, to about the twenty-fifth

degree of south latitude; and are especially numerous in those vast forests which occupy the plains between the rivers Oronoko and Amazons, and which are so little interrupted, save by the intervening streams, that the Monkeys might almost pass along the tops of the trees, for several hundred miles together, without touching the earth. Of these forests, they are the chief inhabitants; all of them being *arboreal* in their mode of life,—that is, residing exclusively in trees.

159. Of the genera which this family contains, we shall notice the principal. The *Ateles*, or four-fingered Monkeys (143), are distinguished by the great length, slenderness, and flexibility of their limbs, and by the prehensile power of their

Fig. 75.—Spider Monkeys.

tails. From the former qualities, they have received the appellation of *Spider Monkeys*. Their movements on the ground are much wanting in firmness, even when they are resting on all the four extremities; giving them the aspect of *crawlers*, rather

than of *walkers*. They tread on the inner edge of the fore-paws, and on the outer edge of the hind-paws; and endeavour to assist themselves by attaching the tail to any object as they proceed. They often assume the erect attitude, however; and then use the tail as a means of balancing themselves. The proper place for these monkeys, however, is among the branches of the forest; their movements are *there* rapid, easy, and unconstrained; and they swing from branch to branch, by means of their spider-like limbs and their prehensile tails, with the greatest agility. The tail is not only an instrument of prehension, but an organ of touch; the end of it is destitute of hair, and furnished with a sensitive skin; and it is capable of seizing small objects with great address. These animals are said to introduce the extremity of the tail, as a feeler, into the fissures and hollows of trees, for the purpose of hooking out eggs or other substances. In the great length of their arms, these Monkeys evidently represent the Gibbons; and they correspond with them also in temper,—being timid, gentle, and contemplative, with more intelligence than most other Monkeys, and displaying agility only when roused.—The *Mycetes*, or Howling Monkeys, are distinguished from the last, by their greater robustness, and by the diminished length of their limbs; by the presence of a thumb, which is, however, not opposable; and by the dilatation of the *os hyoides* (ANIM. PHYSIOL. § 684) into a hollow drum, which communicates with the larynx, and gives great additional resonance to the voice. The howlings uttered by the troops of these Monkeys are described by travellers as astounding. They are usually sent forth early in the morning, at sunset, and during the darkness at night; but they are also heard when the overclouded sky threatens an approaching storm. In their dispositions the Howlers are melancholy and morose; their movements are tardy and inert, and, when on the ground, they never attempt to walk on the hinder limbs alone. They feed principally upon fruits and leaves.—In the genus *Cebus*, comprehending the Monkeys known as *Sapajous*, *Sajous*, and *Capucins*, the tail is covered with fur to its extremity; so that, although it is still prehensile, it is not so delicate an organ of touch as in the pre-

ceding genera. The thumb is present on all the extremities. These Monkeys are for the most part of small size, and are very

Fig. 76.—White-throated Sajou.

lively and docile in their tempers, as well as active in their movements; but they are somewhat capricious in their dispositions. In their native forests, they live in troops; feeding on fruits, grain, eggs, and insects, in obtaining which they display great address. They have been termed Weepers, from the plaintive, piping noise which many of them utter.

160. In the other genera of Cebidæ, the tail is but very little, or not at all, prehensile, although it is frequently of considerable size, and sometimes invested with a covering of very long hairs. This is the case with the genus *Pithecia*, which includes the *Sakis*, or Fox-tailed Monkeys; these animals live in small troops of ten or twelve individuals, usually residing in the outskirts of forests, bordering rivers; and, like the Howlers, utter loud cries before sunrise and after sunset. They display a morose and savage temper; menacing the offender with their

teeth, upon very slight provocation. In their dentition, they somewhat approach the Lemurs.—The genus *Callithrix* comprehends the Sagoins, or Squirrel Monkeys; a group of little animals which are extremely light, active, and graceful in their movements, as well as elegant in their forms; and presenting no inconsiderable resemblance to the Squirrel in their general aspect.

Fig. 77.—Squirrel Monkey.

though differing from it most completely in the shape of the head. Though the tail is completely destitute of prehensile power, it is used as a protection against cold; to which these animals are acutely sensitive. Their food seems to consist more of insects, eggs, and small birds, than of fruits; and although habitually gentle and timid, they become animated even to ferocity at the sight of living prey. The day is their period of activity; and they pass the night in repose.—Nearly allied to these is an interesting genus (*Nyctipithecus*), of which one species is well known as the *Douroucouli;* these animals seem to represent the Lemur tribe in America; their habits are completely nocturnal, and their movements almost cat-like. Another curious form is that presented by the genus *Brachyurus*, in which, as its name implies, the tail is unusually short; it is, however, so thickly covered with hair, that in some species it looks like a roundish knob. The *Marmozets*, or *Oustitis*, belonging to the

genus *Hapale*, are distinguished from the rest of the American Monkeys by the absence of the additional molar, and by the sharpness and crookedness of their nails. The thumb is not opposable, being placed in the same line with the other fingers; and that of the hind feet is very short. The tail is large, and thickly covered

Fig. 78.—Oustiti.

with hair; but it is not prehensile; and its principal purpose seems to be the regulation of the movements, and the prolongation of the leaps, as in the Squirrel. They are very nimble and agile in their movements, and extremely cautious in their habits, retreating at the slightest alarm; though they will defend themselves with great spirit when actually attacked. When in confinement, they still exhibit a degree of wildness and distrust, which it is difficult to overcome completely; and they do not show the same marks of attachment to those who treat them with kindness, as most other Monkeys display. Their intelligence does not seem high; and their brain is almost destitute of convolutions; but they show much instinctive sagacity in their search for food, especially insects, which they devour with eagerness. In their manner of holding their food, they strongly remind us of the Squirrel; for they do not grasp it with the fingers, but press it between the two fore-paws. In many species, the tail is marked by transverse bars, giving it a very elegant appearance; and several are also distinguished by tufts of hairs, projecting from the sides of the head.

161. The last family of Quadrumana, that of the Lemur-

IDÆ, or *Lemur* tribe, presents a combination of characters, which, although no single one may be very striking in itself, evidently points out the animals it contains, as forming the link between the typical Quadrumana, and the lower classes of Mammals. They agree with the Simiadæ in having opposable thumbs on both pairs of extremities, but differ from them in dentition. The number and form of the teeth vary in the different genera. Not unfrequently the incisors appear to be 6 below, instead of 4; but this is owing to the peculiar form and position of the lower canines and first molars,—the former seeming like additional incisors, and the latter taking their place as canines. In the true Lemurs, the formula is as follows :—incisors $\frac{4}{4}$, canines $\frac{1-1}{1-1}$, molars $\frac{6-6}{6-6}$. The contour of the body is very peculiar. The general form is slender and elongated; the head pointed, and somewhat fox-like; the nostrils terminating at the end of a

FIG. 79.—HAND AND FOOT OF LEMUR.

sharp, naked, and somewhat prominent muzzle; the eyes large, as in nocturnal animals; and a long curved claw on the first (sometimes the first two) fingers of the hind feet. This last character serves to distinguish them from all other Quadrumana. The tail varies in length; being sometimes large, and sometimes

nearly absent; it is never prehensile. The form of the skull would of itself indicate the inferior grade of these animals. The size of the cranial cavity is greatly diminished, in proportion to that of the face; no trace of a forehead remains; and the head is placed (as it were) at the end of the neck, as in the lower Mammals, instead of being seated upon it, as in Man and the Quadrumana. The orbits are not completely walled in, but open behind into the temporal fossæ,—the sunk space on either side of the skull, which lodges the temporal muscle (ANIM. PHYSIOL. § 621, 624): this is a character of marked degradation. The tubercles of the molar teeth are no longer rounded; but are raised into points, which lock into each other, as in the Insectivora. Their canines are sharp; and their tongue is rough, as in the Cat tribe. It is evident that they are much more adapted for an animal diet, than are the typical Quadrumana; and they show great address in seizing this, as well as courage in defending themselves when attacked. In consequence of the length of their hind legs, which (contrary to the general rule among the Monkeys) greatly exceeds that of the anterior extremities, they are for the most part agile leapers; but the greater number of them are active only during the night, spending the whole day in sleep, and always secluding themselves as completely as possible from light, which seems painful to them.

162. Nearly all these characters are most completely manifested in the true *Lemurs*, which are the types of the family. These animals are exclusively confined to the island of Madagascar, where they replace the Simiadæ; none of these being found there. They are gentle and harmless animals: but will defend themselves with great resolution when attacked, and inflict severe wounds with their sharp canines. In their natural haunts they associate in troops; and send forth a hoarse dissonant roar, which fills the woods after sunset. They have little of the prying, mischievous, petulant disposition of Monkeys; but seem also destitute of their intelligence. Their fur is usually very fine and silky; and the tail long and bushy. Nearly allied to the Lemurs, but differing from them in not possessing a tail, and in having the tubercles of the molar teeth more pointed, are the

Loris, or Slow Lemurs; which are natives of India and the adjacent islands. They are remarkable for the slowness and

Fig. 80.—White-Fronted Lemur.

caution of their movements, and for the tenacity of their grasp which is due to their power of keeping up muscular contraction for a long time. They are completely inactive during the day; but at night they prowl stealthily among the branches in search of food. Having detected their prey, which consists chiefly of insects and small birds, they approach it with the greatest wariness; and, when they are within reach of it, they pounce upon it with the utmost certainty. They devour eggs greedily, and seem also partial to fruit. When irritated during their period of repose, their motions are very languid; and they utter a

plaintive drawling cry, which somewhat resembles that of the American Sloths.—Several other genera of Lemurine animals are found in Africa and the Indian Archipelago: of these we may mention the *Perodicticus* or *Potto*, which is distinguished by the absence of the first-finger of the hands (Fig. 81); the *Tarsius*, or *Malmag*, in which we find the bones of the tarsus very much elongated, and the hind-legs resting only upon the points of the toes, as shown in Fig. 82; and the *Otolicnus* or *Galago*, which, with the same peculiarity, combines the large membranous ears of the Bats, which double down when the animal is at rest. All these are nocturnal in their habits, and feed partly upon fruits, partly upon insects, and small mammals, birds, or reptiles. The teeth of the Tarsiers present several peculiarities, which are interesting as showing the tendency to irregularity in this respect, in the aberrant forms of this family; of which tendency, a very striking example will be presently noticed. The upper canines are very small; and the middle incisors are of great length and resemble canines; the lower incisors are only two in number, and have more of the ordinary form and direction.

Fig. 81.—Hand of Potto.

Fig. 82.—Foot of the Malmag.

163. To a family allied to the Lemurs we must refer a very remarkable animal, the *Galeopithecus*, or *Flying Lemur*, sometimes termed the *Colugo;* a native of the Moluccas, Philippines, and other islands of the Indian Archipelago. Its chief peculiarity

consists in the extension of its skin between the anterior and posterior limbs on each side, and also between the two posterior limbs, including the tail; so as to form a parachute of considerable extent, which, though it does not enable the animal to *fly*, gives it support in the air, sufficient to enable it to take long sweeping leaps from tree to tree with the utmost facility (ANIM. PHYSIOL. § 668). The extraordinary combination of characters exhibited by this animal, has caused great doubt to be entertained by Naturalists, as to its proper place in the scale. By Cuvier it was placed at the end of the series of Bats; and by Geoffroy among the Carnivora. The situation assigned to it by Linnæus, however,—who regarded it as connecting the Lemurs and the Bats,—is probably the true one. The general aspect of the head is Lemurine, the extremities are all furnished with five fingers, of which the first (or thumb) is separated from the rest, but does not antagonise with them, being short, whilst the remaining four are nearly equal, and are all armed with large, deep, hooked, sharp-edged, and pointed claws,—resembling those of the Cat tribe. The incisors are four in each jaw; but the upper ones do not meet in front, a wide interval being left between the two pairs: the canines are absent in the upper jaw, but present in the lower; the molars are six on either side in each jaw, and are raised up into pointed tubercles. During the day, these animals remain in the depths of the forests, suspended like Bats from the branches, with the head downwards, and clinging by their hind claws. At night they rouse themselves; and are active in traversing the trees in every direction; sweeping from one to another with great address in search of their food, which consists, like that of the Lemurs in general, of fruits, insects, eggs, birds, &c.—As we find a similar parachute-like expansion existing in other groups of Mammalia, it is evident

FIG. 83.—GALEOPITHECUS.

that we are to regard its presence as an *adaptive* character only; and that we are to be guided, in determining the place of this species, by its *essential* characters (§ 25), which, as regards the conformation of its teeth and extremities, are those of the Lemurs, more than of any other group.

164. As the *Galeopithecus* leads us towards the Bats, so does another curious modification of the Lemur type conduct us towards the Rodentia; in which order it has been placed by Cuvier and other eminent Zoologists. This is the *Cheiromys*, or *Aye-Aye*, a native of Madagascar; an animal, which is very rare even in its native country, and of which only one specimen has been brought to Europe. In its general conformation it is strictly Lemurine, though having much of the aspect of a Squirrel. The bones of the fore-arm are movable on one another, which is not the case with those of the Rodentia; and the extremities have five fingers, of which the first is separated from the rest, and shorter, so as clearly to represent the thumb, although it is not opposable; the first toe is armed with a straight-pointed claw, as in the Lemurs. Its habits, too, are those of the Lemurs; during the day it conceals itself in some hollow, and passes its time in sleep; but at night it issues forth in search of its food, which consists of buds and fruit, with insects and larvæ, like that of the Lemurs in general. It was remarked upon two specimens kept in captivity, that they never set up their long bushy tail in the manner of a Squirrel; but always kept it trailing at length.—It is in the conformation of the teeth, that the chief relationship to the Rodentia is shown. Each jaw contains only two front teeth, which are very large and strong, flattened at the sides, and very deep from back to front; their roots extend backwards along

Fig. 84.—Aye-Aye.

almost the whole length of the jaw; whilst their points are sharp, and resemble the end of a ploughshare. Between these and the molars, there is a wide interval, as in the Rodents; the molars, however, are not formed in the manner of theirs, with transverse ridges of enamel, but are simple in their structure. It is doubtful whether the front teeth are to be regarded as incisors or canines; it is not improbable that they really represent the latter, since in several of the Lemuridæ we find the real incisors very small, whilst the canines project forwards, and almost take their place. The bony portion is completely surrounded by enamel; which is not the case in the Rodentia, in whose cutting-teeth the enamel occupies the front edge only: and it is believed that the teeth do not continue to grow from permanent pulps, as in that order (ANIM. PHYSIOL. § 177).—One of the points in which the Aye-Aye strongly resembles the Rodentia, is the position of the mammary glands; which are situated near the groin, and not on the chest, as in the Quadrumana generally. But in the *Tarsiers* (§ 162), *two* pairs of mammæ are present,—one on the chest, the other in the groin;* so that the Aye-Aye does not depart so widely, in this respect, from the general type of the Lemurs, as would be at first supposed.

ORDER III.—CHEIROPTERA.

165. The animals of this Order, all of them commonly known as *Bats*, are distinguished from all other Mammalia by the power of *flight;* that is, they are able not only to sustain themselves in the air, but also to move through it in any direction they may desire (ANIM. PHYSIOL. § 668, 669). This power they derive from the peculiar conformation of the anterior member, the bones of which are very much prolonged, especially those of the fingers; and constitute a framework (like that of an umbrella), over which is spread a thin membrane, continued from the skin of the body, but not clothed with hair. The organs thus formed are

* The same conformation sometimes presents itself in the Human female.

true *wings;* being capable of motion in such a manner, as to strike the air, and thus to raise or propel the body by the resistance which it affords to their extended surface. In their function, therefore, they are completely analogous to the wings of Birds; which class may be considered as *represented* by the Bat tribe among the Mammalia. And in their structure they only differ in this respect,—that the expanded surface, which is given in Bats by the extension of the skin itself over a complex bony framework, is afforded in Birds by the feathery appendages, which are supported upon a framework of much simpler construction.—On looking at the skeleton of the Bat, we observe, in the first place, that the *humerus* or arm-bone (*h*, Fig. 85,) is long and large in proportion to the body; but that the lengthening is still more remarkable in the bones of the fore-arm, *cu*, *r*.

FIG. 85.—SKELETON OF BAT.

cl, clavicle; *h*, humerus; *cu*, ulna; *r*, radius; *ca*, carpus; *po*, thumb; *mc*, metacarpus; *ph*, phalanges; *o*, scapula; *f*, femur; *ti*, tibia.

The bones of the carpus, or wrist, *ca*, do not show any considerable increase; but the most extraordinary extension is seen in the metacarpal bones of the four fingers, which spread out widely from each other when the wing is extended, but are capable of being closed together, like the stretchers of an umbrella. Upon these are situated the phalangeal or true finger-bones, *ph*; the

number of which varies in different genera; being only one in the first finger, but four in the second, in the specimen here figured. These taper to a point, and are not terminated by claws or nails. The thumb, however, does not partake of this extension in length, nor does it assist in the support of the wing-membrane; but it is short and free, and is terminated by a hooked claw. The clavicle, *cl*, and scapula, *o*, to which are attached the muscles that move this member, are of great strength; and the sternum, or breast-bone, has a keel-like projection, similar to that which exists in Birds (ANIM. PHYSIOL. § 89) for the attachment of the powerful muscles by which the wing is drawn down. The hinder limbs do not present anything peculiar in their structure; they serve to assist in keeping the wing-membrane extended (as does also the tail, where it exists); and the toes are five, armed with sharp claws, by which the animal can suspend itself, when at rest in its retreat.

166. The whole powers of the animal seem concentrated upon its organs of flight; and when it is neither asleep nor torpid, this kind of movement is evidently its natural condition. It can only move along a solid surface, by folding its wings, and using the hooked thumbs to lay hold of any inequality, and to draw itself forwards. Hence its motions are awkward and shuffling; and on a polished surface, like that of a table, it is greatly embarrassed. But in the hollows of trees, the crevices of masonry, and the chinks or fissures of a rock, it can climb and crawl about with great facility. The air, however, is its home; and through this it moves with vast rapidity, and with great apparent ease, wheeling in every direction in search of its insect prey, and performing the most abrupt evolutions to secure it. In these movements it is very much assisted by the tail, which serves as a rudder; and we shall find that this organ is most developed in the Bats which pursue insects on

FIG. 86.—BAT WALKING.

the wing, whilst it is small or entirely wanting in those which live on fruits. In their mode of flight, Bats bear a very strong resemblance to Swallows, which like them pursue insects on the wing ; but whilst the latter seek their food during the day, the former come forth only at twilight ; and thus the Bats exercise the same purpose in the economy of Nature, in restraining the multiplication of the *crepuscular* (twilight-flying) and nocturnal insects, as the Swallows do in regard to the diurnal. During the day, the Bats sleep in their recesses, suspended by their hind-feet, their heads consequently hanging downwards (Fig. 92) ; and they assume the same position during the whole winter, which is passed by them (in our climate at least) in a state of torpidity.

167. The senses of hearing and smell are developed in Bats to an extraordinary degree ; as we might judge by the size of the organs, especially in the insectivorous species. In the long-eared Bat of this country (Fig. 91), the external ear is nearly as long as the body ; and there is frequently an inner fold, which seems like a smaller ear within the principal one. The nose, again, frequently presents an extraordinary development, being furnished with curious leaf-like appendages, formed by a prolongation of the skin, which is folded and doubled in various directions, so as frequently to present a most grotesque appearance. The membrane of the wing, too, is endowed with a very high degree of sensibility, so as to receive impressions from the resistance of the air, which guide the animal in its flight through the darkest recesses, preventing it from striking against obstacles, even in a complete labyrinth (ANIM. PHYSIOL. § 495). The eyes are usually small, and can be of little use to those which pass nearly their whole time in obscure caverns, or in the dark chambers of old buildings.—On the other hand, the frugivorous species, which sail over gardens, plantations, or forests, in search of their food, are guided chiefly by their sight ; their eyes are accordingly rather large than otherwise, whilst the ears and nose have no extraordinary development.

168. The *insectivorous*, or insect-eating, Bats constitute by far the largest division of the Order ; they are recognised, not only by the characters already noticed, but by the conformation

of their teeth and digestive system, which is in accordance with their particular kind of food. Their molars are beset with pointed tubercles, adapted to crush the hard envelopes of Insects; and their canines are not unfrequently of large size, as shown in the accompanying figure of the Head of *Vampyrus spectrum*. The intestinal canal is short, and is evidently adapted to the digestion of animal food ; in the Great Bat of our own country it is only twice the length of the body ; whilst in the true Vampyres of South America, which chiefly live on the blood of other animals, it proceeds from the mouth to its opposite termination nearly in a straight line. The Bats of this division are arranged under four families :—(I.) Rhinolophidæ, in which the nose-leaf is of complicated structure, and formed of membranous folds ; the first or fore-finger has but one joint ; and the wings are large and broad. (II.) Phyllostomidæ, which have but a simple and fleshy appendage to the nose, and a fore-finger of two joints. (III.) Vespertilionidæ, which are altogether destitute of nose-leaf, but have broad and large wings, and a prolonged tail, but with only a single joint in the fore-finger. (IV.) Noctilionidæ, which are also destitute of nose-leaf, but have long narrow wings, and a short thick tail, with two joints in the fore-finger.

Fig. 87.—Head and Skull of Vampyrus Spectrum.

—These families are all distributed in large numbers over a considerable part of the globe, extending almost to the coldest regions; but it is in tropical regions that the Bats are most abundant, and attain the largest dimensions. No fewer than fifteen species are known to inhabit this country; of these, all but two belong to the family Vespertilionidæ.

169. The family RHINOLOPHIDÆ, distinguished from the other insectivorous Bats, by the extraordinary development of the nasal appendage, contains a large number of species, most of which are inhabitants of the Eastern hemisphere, especially the islands of the Indian Archipelago. Two species are known in England, under the name of the *Greater* and *Lesser Horse-shoe Bats;* which designation they have received from the peculiar form of the front of the nose-leaf. These animals are not common; for they inhabit only the darkest and least accessible caverns, subterranean quarries, and other like situations, scarcely ever coming forth into daylight. Hence their habits are but little known. Most of this family are remarkable for the great development of their integuments; in the *Megaderms* of Africa and the Indian Archipelago, there is not only an enormous nose-leaf, but a very large pair of ears; the wings too, being of great size; whilst in the *Nycterins* of the same countries, the skin is loosely attached to the body, and may be distended by air blown beneath it, so as to make the animal look like a little balloon, furnished with head, wings, and feet. This is done by the animal itself, through an aper-

FIG. 68.—HEAD OF MEGADERMA FRONS

ture at the bottom of the cheek-pouch on each side; these apertures are furnished with a circular muscle, which prevents the return of the air except at the will of the animal; and large valves for the same purpose exist in the head and back. The use of this singular provision is not known, unless it be for diminishing the specific gravity of the body, by increasing its bulk; which seems to be at least one of the purposes answered by the air-cells of Birds.

170. The Bats of the second family, PHYLLOSTOMIDÆ, are for the most part inhabitants of South America; where they may be regarded as representing the preceding. Although the greater number of them are insectivorous, there are several species which seem destined to subsist on the blood of other animals; possessing a peculiar arrangement of the front teeth for making the incision; and a conformation of the tongue, which specially adapts it for suction. This is the case with the genus *Desmodus*, which includes the *True Vampyres*. The upper jaw is furnished with two large upper incisors in the centre, and two lancet-shaped canines, separated from them by an interval; all these teeth are extremely sharp-pointed. In the lower jaw there are four smaller incisors, with a space in the centre into which the upper ones pass when the jaw closes; the canines also are smaller than those of the upper jaw. By these teeth, a deep triple puncture will obviously be made. The molars are imperfectly developed; and seem unfit for mastication; and the intestine is shorter than in any known animal of its size. One of these bats was taken by Mr. Darwin, during his travels in South America, in the act of sucking blood from the neck of a horse; and he states that the injury which horses sustain from their attacks, is due, not so much to the loss of blood, as to the inflammation which the bite produces, and which is aggravated by the pressure of the saddle,

FIG. 89.—TEETH OF DESMODUS.

if this be put on too soon. The species to which the name of *Vampyre* is commonly attached (Fig. 87), is about the size of a Magpie, its wings measuring two or three feet across, when expanded; it seems to have similar blood-thirsty propensities to those just described; but from the structure of its teeth it may be imagined to be less exclusive in its tastes than the preceding. Many marvellous stories have been told of the performances of these animals; but they contain much fiction mingled with some truth. There is no well-authenticated instance of any animal larger than a fowl ever having died from the effect of their bite; although their attacks are so frequent that, according to the testimony of some travellers, the horses and mules turned out to graze at the end of a day's journey, are often brought in by the guides in the morning with their shoulders and haunches covered with blood; nor is it an uncommon thing for the Vampyres to enter the habitations of the natives, and fasten on the legs of some incautious sleeper, who has not secured his feet within the coverlid. But "nobody fears these animals, or gives himself any trouble about them." The story of the Vampyre fanning its victim with its large wings, to keep him cool, and render his sleep more profound, is probably a fiction of the imagination.—In *Glossophaga* the tongue is long and extensible, and is said to be employed in suction.

171. To the third Family, VESPERTILIONIDÆ, most of the Bats of temperate climates belong; and the number of species of these is very numerous, no less than fifteen being natives of Britain. Of these one of the largest is the *Vespertilio noctula*, the *Noctule*, or *Great Bat*, which measures fifteen inches across the wings; this is gregarious in its habits, associating in considerable numbers; and seeks its retreat sometimes in the hollow of trees, at others under the roofs and eaves of houses. The *Vespertilio murinus*, or *Mouse-coloured Bat*, exceeds the preceding by about an inch in the expanse of its wings; it is very common in many parts of the Continent, living in ancient buildings, the towers of churches, &c., but not resorting to the woods; and is the one usually implied by continental writers as *the* Bat, or Common Bat; in Britain, however, it is very rare. Although gregarious

in its habits, it is very quarrelsome, and will fight desperately with its fellows.—The *Vespertilio pipistrellus*, the *Flitter-Mouse* of some country people, is ordinarily known in Britain as the Common Bat; being, with the Long-eared Bat, the most abundant of the tribe. This species has a shorter period of torpidity than any other, coming forth from its winter quarters as early as the middle of March, and not permanently retiring until the winter has decidedly set in. Its food consists especially of gnats and other dipterous (two-winged insects) and as long as these are to be found, the Bat seems to remain in activity,—coming forth, as the season advances, during the daytime rather than at night, since then only is the temperature sufficiently elevated to call forth its insect prey. The Pipistrelle frequents the haunts of Man more than any other species; its usual retreat being under the roofs of houses, and in the nooks or crevices of buildings of every description,—as, for instance, in the cracks of old door-frames, or behind the leaden rain-pipes. In its flight, which is quick and flitting, it particularly frequents the neighbourhood of rivers, flying about the trees which grow on the banks, or over the surface of water, in search of gnats and other small insects. It will readily feed, however, on meat; being easily supported on this diet in confinement; and even sometimes finding its way into larders, and making a hearty meal upon the joint it finds there.—The *Plecotus auritus*, or *Long-eared Bat*, is remarkable, as already mentioned, for the extraordinary development of its external ears; these are beautifully transparent, and are often thrown, by the will of the animal, into the most elegant curves.

Fig. 90.—Common Bat.

It is very easily tamed, and is soon brought to show a considerable degree of familiarity with those who feed and caress it,

FIG. 91.—LONG-EARED BAT.

so as to take a fly from the hand, or even from between the lips. It is very playful in confinement, when placed with others of its own species, its gambols being very amusing; and it is very cleanly in its habits. The ears are usually folded under the arm during sleep and hybernation; and its appearance is so remarkably altered by this action, that it would be scarcely supposed to be the same animal, by a person who had not witnessed the change. It has an acute and shrill, but not a loud cry; but when disturbed, the sound becomes more piercing. Its retreat is nearly the same as that of the Common Bat; and in some parts of the country it is the more abundant of the two.

FIG. 92.—LONG-EARED BAT IN REPOSE.

172. The Bats of the fourth family, NOCTILIONIDÆ, are almost exclusively confined to tropical countries, where a large

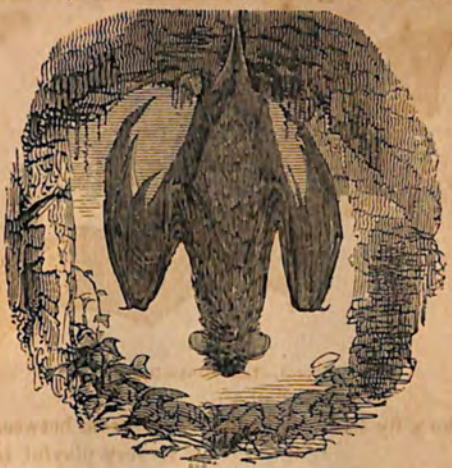

FIG. 93. NOCTILIO.

number of species exist,—some in the Eastern, and others in the Western hemisphere. Little is known, however, of their

FIG. 94.—DYSOPUS CHEIROPUS.

habits. The *Noctilios*, or *Noctules*, of South America, are, com-

monly known as *Bull-dog Bats*, on account of their short thick muzzle, which is cleft, in some species, by a furrow like that in the lip of a Hare. The tail sometimes projects beyond the membrane connecting the hind-legs; and the claws of the hind-feet are large and strong. The length of the body is about four or five inches; and the spread of the wings at least a foot and a half. In an East Indian genus, *Dysopus*, or *Cheiromeles* (Fig. 94), the wings of which measure nearly two feet across, the hinder thumb is placed at a distance from the rest of the toes, and is capable of being opposed to them,—a character which obviously connects this group with the Quadrumana. The tail is here short; and there is an almost entire absence of the membrane connecting the hind-legs.

173. The Bats of the *frugivorous* section have molar teeth with rounded eminences, for bruising and grinding their food; and the complex structure of their stomach, with the length of the intestinal canal (which in the *Pteropus* is seven times that of the body), also indicate that they are destined to subsist, in part at least, upon a vegetable diet. Like many of the Monkeys, however, they are probably in a degree omnivorous; feeding chiefly upon fruits, but pursuing small birds or large soft-bodied insects (such as moths), which may be obtained without much difficulty. This tribe contains but one family, the PTEROPIDÆ; which is characterised by the entire absence of the nose-leaf, the simplicity of the ears, the shortness of the tail, and the absence (partial or entire) of the membrane stretching between the thighs. The Bats of this family are widely diffused throughout the tropical regions of the Old World; and many of them exceed in size any others of the order. One of the most remarkable species is the *Pteropus edulis*, the *Kalong Bat* of Java, a Bat with a fox-like head, the expanse of whose wings is no less than five feet. It is very abundant in the lower parts of the island, and lives in troops, which do not appear to visit the more elevated districts. Numerous individuals, says Dr. Horsfield, select a large tree for their resort; and suspending themselves by the claws of their hind-limbs to the naked branches, often in companies of several hundreds, afford to a

stranger a very singular aspect,—being readily mistaken for a part of the tree, or for a fruit of uncommon size suspended from its branches. In general these animals preserve a perfect silence during the day; but if they are disturbed, or a contention arises among them, they emit sharp piercing shrieks: and their awkward attempts to extricate themselves, when oppressed by the light of the sun, exhibit a ludicrous spectacle. In consequence of the sharpness of their claws, their attachment is so strong, that they cannot readily leave their hold without the assistance of the expanded membrane; and if suddenly killed during the day, they continue suspended after death. Hence, if it be desired to obtain them in the day-time, it is necessary to cause them to take wing by alarming them. Soon after sunset they successively quit their hold, and pursue their nocturnal flight in quest of food. They direct their course by an unerring instinct to the forests, villages, and plantations, attacking fruit of every kind, and doing a vast amount of mischief. In order to protect valuable fruits from their ravages, the natives are obliged to inclose them in nets or baskets. There are few situations in the lower parts of Java where this night-wanderer is not constantly observed; as soon as the light of the sun has retired, one animal is seen to follow the other at a small but irregular distance; and this succession continues uninterrupted, till darkness obstructs the view. The flight of this Bat (termed by the natives, the Kalong) is slow and steady, pursued in a straight line, and capable of long continuance.—The *Harpy'a Pallasii* of Timor, is a sin-

Fig. 95.—Head of Pteropus.

gular looking Bat, having nostrils projecting in a kind of cylinder, and a claw on the fore-finger.—The flesh of many of the

Fig. 96.—Harpyia Pallasii.

frugivorous Bats is eaten as a dainty by the inhabitants of the countries in which they are found; having a flavour which has been compared to that of the hare and partridge. It is possible that some of larger species, which may have been known to the ancients, gave rise to the fabulous account of the Harpy.

Order IV.—INSECTIVORA.

174. Although, as we have already seen, a large proportion of the Bat tribe, as well as many of the lower Quadrumana, are adapted to derive their chief support from Insects, and have their teeth and their general conformation arranged accordingly, yet it is in this order that we find these characters developed to their fullest extent. Though the animals which it contains differ very greatly in other respects,

Fig. 97.—Teeth of Insectivorous Animal.

yet they all agree in having the teeth raised into conical and pointed tubercles, for the purpose of crushing the hard envelopes of their insect prey. They agree also, in being for the most part nocturnal animals; and, with some exceptions, in living underground, or at least in exhibiting a tendency to such a mode of life; and all those which inhabit cold countries pass the winter in a state of torpidity. They are timid little creatures; and although constantly at work around us, and in a manner most important to our welfare, their habits are so unobtrusive as to escape our observation. They are especially appointed to check the overwhelming increase of the worm and insect tribe, and especially of those species which live beneath the soil; the ravages of which, if not thus kept within bounds, would be speedily destructive to man and beast, by preventing the growth of those vegetables on which they depend for food. Their general conformation varies according to their mode of life; but they agree in the possession of clavicles, and in the application of the sole of the foot to the ground; and their limbs are generally short.—The order may be divided into four families; which are characterized by their habits, as well as by their external form and internal structure. 1. The TALPIDÆ, or *Mole* tribe, which are pre-eminently subterranean, and are distinguished by their extraordinary habit of forming long complicated burrows underground, in which they are born, and in which they pass their whole lives,—feeding, hybernating, breeding, and dying, in these subterranean retreats. 2. The SORICIDÆ, or *Shrew* tribe, which are a sort of carnivorous mice; these, although they do not actually burrow, retreat during the winter, and for their ordinary repose, into holes; they feed, however, on the surface and in the water,—several of them being purely aquatic, diving with facility after aquatic insects, and remaining a long time under water without inconvenience. 3. The ERINACEADÆ, or *Hedgehog* tribe, contains animals which do not burrow or descend into deep excavations; but which conceal themselves during hybernation beneath a covering of leaves, or in some superficial hollow; and which live upon food that they find either upon or near the surface. These are further characterised

by having the body covered with spines, instead of with hair; and by being for the most part capable of rolling the body into a ball, so as to present nothing but spines on every side, to their enemies. 4. The TUPAIDÆ, or *Banxrings*, which live on trees, and climb them with the agility of a Monkey or a Squirrel; these are evidently allied to the insectivorous Quadrumana.

175. Of the TALPIDÆ we may take the common *Talpa*, or *Mole*, of this country for an example. The general form and aspect of this animal are well known, and the remarkable conformation of its anterior extremities, by which it is enabled to dig its extensive subterranean excavations, has been already noticed (§ 90). It here only remains, therefore, to describe certain other peculiarities, in its structure and habits, which are of great interest. The head is much prolonged, especially the muzzle, which projects far beyond the jaws, and is very flexible, serving to seize and convey food to the mouth; it is furnished with a little bone at its extremity, which renders it a very efficient borer. The portion of the bones of the face appropriated to the organ of smell is very large; and that sense appears to be very acute. On the other hand, there is scarcely any hollow for the reception of the eyes; which organs are but little developed, and do not receive a true optic nerve. There is good reason to believe, however, that the common Mole possesses some degree of sight; although the Mole of Italy and Greece, which is a different species, is completely blind. The apparatus of hearing is very highly developed; so that, although there is no external ear, the sense is probably very acute. Thus the deficiency of sight,—which could very seldom be of use to an animal that rarely shows itself above the surface of the ground,—is compen

FIG. 98.—COMMON MOLE.

sated by the high development of the senses of smell and hearing, which are much more adapted to communicate information to it in its subterranean abode. The body of the Mole is nearly cylindrical in form, and is thus evidently adapted to move readily through its tunnels; it is covered with a very soft thick fur, the hairs of which are inserted vertically in the skin, and lie smoothly in every direction, so as not to offer more resistance to the backward than to the forward movement of the animal. The form of the anterior limbs, and the powerful muscles with which they are furnished, enable the animal not merely to dig through the soil, cutting through the roots, &c., which may traverse it; but also to throw backwards with great energy the earth which has been removed at each stroke. The hind limbs are small, and the feet feeble, in comparison with the anterior; but they serve to enable the animal to run through its galleries with great rapidity. The food of the Mole consists chiefly of earth-worms and the larvæ of insects; in search of which it makes a large part of its extensive subterranean excavations. But it is not confined to these; for during the summer months it not unfrequently leaves its runs under the turf, and wanders during the night upon the surface (occasionally also during the day), in quest of prey, such as birds, mice, frogs, lizards, snails, &c.; and during these nocturnal excursions, it not unfrequently falls a prey to the Owl. It is an extremely voracious animal, taking a large quantity of food at a time, and so soon requiring more, that a short fast proves fatal. Its hunger amounts to rage; and under the influence of this passion, it fastens on its prey with intense eagerness. It is fierce and combative in its disposition; and will attack and devour its fellows, if confined with them, without a due supply of food. The very remarkable excavations made by the Mole, which are formed upon a regular plan, and have several distinct purposes, will be described in that portion of the Treatise, which will be particularly appropriated to the Habits and Instincts of Animals.

176. There are a few other animals, in different quarters of the globe, which correspond with the Moles in general structure and habits, but which differ from them in some important features.

Among the most curious are the *Chrysochloris*, or *Cape Mole*, which is distinguished by the splendid colours of its fur, and is the only known Quadruped, which exhibits anything like the metallic lustre that adorns numerous birds, fishes, and insects: —and the *Condylura*, a Mole-like animal of North America, which has the termination of the nostrils surrounded by movable cartilaginous points, that radiate like a star when expanded. The use of this curious apparatus is unknown. The *Scalops aquaticus*, or *Shrew-mole* of Canada and the United States, constitutes a singular transition to the next family.

177. Of the family SORICIDÆ, the common *Sorex*, or *Shrew*, of this country may be taken as the type. This is a small animal, covered with a velvety fur, and having much of the general form and aspect of the mouse; indeed it is commonly known by the name of Shrew-mouse, and believed to be nearly allied to that little animal. The Shrews may be easily distinguished, however, by their long taper movable snout; their eyes, too, are very minute, and almost hidden in the surrounding hairs; and their ears are small and close. The body exhales a musky odour, which renders them distasteful to cats, though these will readily destroy them; but it does not seem to be disliked by weasels, hawks, and owls, which destroy these little nocturnal Insectivora in great numbers. They are common in hedge-rows, thickets, gardens, &c.; and make long superficial burrows, or *runs*, in banks, and among the roots of trees or brushwood; the female makes a sort of nest of soft herbage, with an aperture at the side. They feed upon worms, insects, &c.; after which they grub with their pointed snout, turning up the loose soil, or making their way through the close herbage; and they show much of the voraciousness and pugnacity of the Mole. Besides the common Shrew, two other species, the Water Shrew, and the Oared Shrew, inhabit this country; the habits of both are aquatic, as their names import, —their burrows being formed in the banks of streams, and their food consisting of aquatic insects and larvæ, in pursuit of which

Fig. 99.—Shrew.

they dive with great facility. The feet and tail are so formed as to strike the water with force; the fur has the power of repelling water (or rather, it has a strong adhesion for air, which prevents water from ever coming into complete contact with it, MECHAN. PHILOS. § 34), so that it is never wetted; and the orifices of the ears can be closed, so as to prevent the entrance of water. The *Desmans*, or *Musk-rats* (Fig. 58), of which one species inhabits Russia, and another the Pyrenees, agree with the Water Shrews in their general habits, but differ in their dentition. They are much larger animals, the head and body measuring ten inches, and the tail seven; and they feed on leeches and small fishes, whilst they become in their turn the prey of the larger, to which they communicate their musky odour. The *Macroscelides* of Africa closely resemble the true Shrews, but have their hind legs a good deal elongated, so that they are enabled to spring in the same way as the equally rat-like Jerboas amongst the Rodent or gnawing Mammalia.

178. Of the family ERINACEADÆ we have also a characteristic example, in the common *Hedgehog*, or *Urchin*, of this country; an animal which is not uncommon in woods, copses, hedgerows, &c., where it remains rolled up in its retreat during the day, coming forth on the approach of twilight, and continuing on the alert until morning. The power of doubling up the body, so as to conceal the head and feet, and to present nothing but a ball, thickly covered with spiny points, is more or less possessed by all the animals of this family; but it is nowhere so striking as in the common Hedgehog, which possesses a peculiar muscle for the purpose. The action of this muscle is not only to roll up the body, but to set up and fix the spines, in such a manner that they shall radiate from the ball. "Deprived by its structure," says Mr. Bell (British Mammalia, p. 76), "of all means of attacking its enemies, of defending itself by force, or of seeking safety in flight, this harmless animal is yet endowed with a safeguard more secure and effectual than the teeth and claws of the Wild Cat, or the fleetness of the Hare. Its close covering of sharp spines,—which are hard without brittleness, sufficiently elastic to bear great violence without breaking, and fixed with

astonishing firmness in the tough, leathery skin,—forms not only a solid shield to protect it from the effect of blows or falls, but a shirt of prickly mail sufficiently sharp and annoying to deter all but a few thorough-bred Dogs, or a half-starved Fox, from venturing to attack it. Immediately that it is touched, or that it sees any danger approaching, it rolls itself up into a compact round ball, and presents this impenetrable panoply, beset by innumerable spines standing out in every direction; and the more it is irritated or alarmed, the more firmly it contracts, and the more strongly and stiffly the spines are set. The strength and elasticity of this covering is such, that I have repeatedly seen a domesticated Hedgehog in my own possession run towards the precipitous walls of an area, and, without hesitation, without a moment's pause of preparation, throw itself off,—contracting at the same time into a ball, in which condition it reached the ground from a height of 12 or 14 feet; after a few moments it would unfold itself and run off unhurt." The food of the Hedgehog in its natural state consists of insects, slugs, frogs, toads, mice, and even snakes, which last it destroys with great dexterity; it also devours eggs, young nestlings, and various kinds of vegetable matter, for some of which it will bore with its long snout. Its fondness for insects occasions it to be kept in many houses in London, for the purpose of ridding the kitchens of the innumerable hosts of cockroaches, by which they are infested. It is easily rendered familiar, but does not manifest any peculiar degree of intelligence. The hybernation of the Hedgehog is very complete; the whole winter being passed by it in a state of complete torpidity. It makes its retreat in banks, under the hollow roots of trees, in holes, or other sheltered and convenient places, constructing a sort of nest or bed of grasses, dried leaves, and moss, with which it covers itself very closely. —The *Tenrecs* of Madagascar and the Mauritius closely resemble the Hedgehog in their general characters; but differ in their dentition, as also in the feebleness of their spines, and in the less complete power of rolling themselves into a ball. Their habits seem to resemble those of the common Hedgehog; but they are active only when the temperature is extremely high. They

exhale a strong musky odour. The *Gymnurus* of Sumatra appears to approach the Tenrecs and Hedgehogs in its dentition, as well as in its spiny covering; but it has the long scaly tail, and pointed muzzle, of the Shrews.

179. The last family, that of the TUPAIDÆ, or *Banxrings*, includes a few remarkable species of animals, which principally inhabit the larger islands of the Eastern Archipelago. Instead of being strictly terrestrial in their habits, like the other Insectivora, they lead the life of Squirrels; and have all the sprightliness and activity, together with much of the general appearance, of those animals. They are covered with soft and glistening hair, and have usually a long bushy tail, although in one curious species, the *Ptilocercus Lowii*, a native of Sumatra, this organ is naked and scaly, except at the extremity, where it bears a row of long hairs on each side, which give it somewhat the appearance of a feather. The skull differs from that of the other Insectivora in having the orbits complete. The Tupaidæ are diurnal in their habits, and their food consists of fruit and insects, which they hold between their fore paws in the manner of a Squirrel.

180. We can scarcely take even a cursory view, like the present, of the different forms contained in the order Insectivora, without perceiving that it offers many striking *analogies* to the Rodentia,—far distant as that order undoubtedly is. The analogy between the Shrews and the Mice, the *Macroscelides* and the Jerboas and Gerbilles, the Hedgehogs and the Porcupines, and the Banxrings and the Squirrels, is very obvious; and it may not be altogether so far-fetched a comparison as it appears at first sight, to compare the Mole and the Beaver,—both being distinguished above all the rest of their respective orders for their instinctive propensities,—these propensities being directed towards the construction of their habitations,—and the whole conformation of each being modified in accordance with its particular object; the dwelling of the Mole being excavated beneath the surface of the ground, and that of the Beaver being erected above it. Altogether it may be affirmed that the Insectivora hold a rank in the Carnivorous division of the Mammalia, analogous to that which the Rodentia take in the Herbivorous. Both would

seem to rank lower than any of the groups to which they bear the nearest relationship, in regard to their intelligence; and, in the economy of both, *hybernation* is a leading feature.

Order V.—CARNIVORA.

181. This group includes all the unguiculated Mammalia, which show, in the structure of their teeth and digestive apparatus, and in their general conformation, an adaptation to a diet consisting of animal flesh. We have seen that, in many tribes which have already come under our notice, there is a power of subsisting in part, or even entirely, upon food of this kind; such is the case, for instance, with Man, and several of the Monkey tribe. But all *these* animals are also capable of digesting, and of subsisting on, food of a vegetable nature also; and where the diet is exclusively animal, as in a large proportion of the Bats, and in the Insectivora, it consists of Insects, Worms, &c., and not of the flesh of larger animals, on which the true *Carnivora*, in a state of nature, depend entirely (with few exceptions), for their support. The members of this order are readily distinguished from all others, by the character of their teeth; which are formed for seizing, cutting, and tearing animal flesh. In the greater number of them, the size of the canine teeth is the most obvious mark of distinction; these are large, strong, and pointed, and project somewhat forwards, so as to present themselves rather in front of the line of the other teeth. Between the canines of the two sides, are six incisor teeth in each jaw; these are of moderate size, but are provided with sharp cutting edges. The molar teeth, situated behind the canines, are usually from four to seven in number; they are of three different kinds;—those which immediately follow the canines

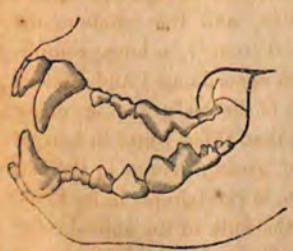

Fig. 100.—Teeth of Carnivorous Animal.

(occupying the same position with the *bicuspid* teeth of Man, ANIM. PHYSIOL., Fig. 92), being more or less pointed, and termed *false molars*;—the next being especially adapted for dividing animal flesh, by the form of its summit, which is raised into a cutting edge, and termed *carnivorous* teeth;—and the last, or hindmost, having summits more or less rounded or *tuberculated*.

182. The proportion which these different classes of molar teeth bear to each other in degree and development, accords with the relative carnivorous propensity of the different families. Thus, in the *Cat* tribe, which in a state of nature is exclusively carnivorous, the tuberculated molars are entirely wanting in the lower jaw, and are very small in the upper; whilst the carnivorous molars are of very large size, and the false molars partake of their form. On the other hand, in the *Bears*, which are adapted to derive a great part of their subsistence from vegetable food, there are three large tuberculated molars on each side of each jaw; and the size and sharpness of the carnivorous tooth are not nearly as remarkable as in the preceding group. And in the *Dog* tribe, which is intermediate in this respect between the two extremes, there are two tuberculous grinders behind each carnivorous tooth; and this tooth is itself partly tuberculated,—that is, a portion of its sharp cutting edge is superseded by a rounded summit. We find the alimentary canal formed in accordance with the character of the teeth; for, the nature of the food being such that it is easily reduced to a fluid form by the process of digestion, and the whole of the nutritious matter being easily removed from it, a long, complicated intestinal tube would have been superfluous; and instead of its length being thirty times that of the body (as in many herbivorous animals), it is no more than three times as long as the body in the Cat tribe, though of greater length in the less carnivorous species. The stomach, too, is very simple in its form, and is of small size in comparison to the bulk of the animal; for the facility with which the food is digested, allows it to pass rapidly through that organ, instead of its being long delayed there, as it is in the capacious paunch of the Ruminantia.

183. The whole conformation of these animals is evidently

adapted to the same purposes. We do not find such differences in the structure of the anterior and posterior limbs, as we have seen in Man, the Bats, and the Mole; all of them are equally adapted for supporting the body on the ground, and for enabling it to execute rapid and energetic movements upon the surface of the earth, as in running, leaping, &c. The only exceptions to this principle are among the aquatic species, such as the Otter and Seal, in which we find an adaptation, more or less complete, for residence in the water; and the comparatively sluggish Bears, a large part of whose life is passed among trees. The muscular energy of the Carnivora is very great; their respiration and circulation very active; and the demand for food, therefore, (on the principles elsewhere stated, ANIM. PHYSIOL., § 140), is very constant. The rapid movement which they require for pursuing a living prey is provided for in the structure of their limbs, which are usually long, and moved by powerful muscles. As these limbs have but little variety of movement (their action in running and leaping being simply backwards and forwards), a clavicle is but little required; and this bone is usually very small, not uniting the shoulder to the breast-bone, and is sometimes almost entirely deficient. In the Bears, however, whose fore-limbs must be kept more apart, for the purpose of climbing, and must be provided with strong muscles to draw them together, we find a more complete clavicle than in most others of the order. The two bones of the fore-arm still remain distinct, and are capable of being in some degree rotated, one on the other, as in Man.

184. In regard to the arrangement of the bones of the hands and feet, we find a marked variation in different species. In the most active, and especially in those which have the greatest powers of leaping, these bones are so connected with those above, as to form nearly a continuous line with them; and the animal rests upon the points only of the toes. But in others, the hands and feet are so united with the limbs above, that the animal bears upon its palms and soles, thus acquiring a firmer footing, but losing in activity. The animals which have the former conformation are said to be *digitigrade*; those possessing the latter

to be *plantigrade*. The *Cats* are an example of the first; the *Bears* of the second. The conformation of the extremities in the *Seals* offers a third variety; for their bones are flattened and shortened, but spread out from one another, so as to give support to the fin-like expansion of the skin, that envelopes and connects them nearly to their extremities. In all instances the phalangeal bones are terminated by claws, which are both strong and sharp, and are usually curved. This is especially the case in the *Cat* tribe; in which there is also a very remarkable provision for enabling the animal to project them only when they are required, keeping them drawn in at other times. The last phalangeal bone, to which the claw is attached, has a rotatory movement upon the preceding one; this movement is effected in one direction by a powerful muscle, which draws the bone downwards and causes the claw to project; whilst there is a ligament composed of elastic fibrous tissue (ANIM. PHYSIOL., § 29), which draws the bone in the other direction, and retracts the claw within a kind of sheath. When the animal is walking, running, or leaping, the claws are thus drawn in, without any exertion on the part of the animal, by the simple elasticity of the ligament; and they are thus secured, either from receiving injury by wear against the ground, or from impeding the movements of the animal by becoming entangled in the inequalities of its surface, or in the vegetation that covers it. In this state of the claws the animal bears upon a number of soft cushions, one beneath each toe; which enable it to steal with noiseless steps upon its prey, and thus, by surprising them, to vanquish animals whose

FIG. 101.—LEG AND CLAW OF LION.

size would make their resistance formidable, or whose swiftness would give them a good chance of escape from direct pursuit. But when they have made their *spring*, the claws are caused to project, by the action of the muscle just mentioned; and they are then used to seize and tear their prey, for which purposes their strength, sharpness, and curved form render them very efficient. The movement here described may be readily observed by every one, in the foot of the Domestic Cat.

185. The division of this order into families is chiefly based upon the conformation of the teeth and extremities, which here afford very constant and distinct characters, and are closely connected with the general structure and habits of the animals. Of those with *digitigrade* extremities, we have, 1. FELIDÆ, or the *Cat* tribe, which is evidently the *typical* family of the order, being the one in which the carnivorous propensity is most strongly manifested, and in which the instruments of destruction are most completely adapted for its exercise. The family is characterised by the short, powerful jaws, the retractile claws, and the peculiar adaptation of the teeth for cutting. The dentition is as follows; incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, false molars $\frac{2-2}{2-2}$, carnivorous molars $\frac{1-1}{1-1}$, tubercular molars $\frac{1-1}{0-0}$. The canines are very large, the molars have sharp edges, the carnivorous tooth is very large and sharp, and the tuberculated molar very small in the upper jaw, and entirely wanting in the lower. 2. CANIDÆ, or the *Dog* tribe, in which the carnivorous propensity is not so strong; the jaws are more elongated, and the claws not retractile. The dentition is as follows; incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, false molars $\frac{3-3}{4-4}$, carnivorous molars $\frac{1-1}{1-1}$, tubercular molars $\frac{2-2}{3-3}$. 3. HYÆNIDÆ, or the *Hyæna* tribe, which combine somewhat of the form of the Dogs, with a dentition approaching that of the Cats, whilst, like the Civets forming the following family, they possess a pouch under the anus. The claws are non-retractile. The dentition is,—incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, false molars $\frac{3-3}{3-3}$, carnivorous molars $\frac{1-1}{1-1}$, tubercular molars $\frac{1-1}{0-0}$. These are followed by two families in which a portion of the sole of the hind feet at least is applied to the ground in walking, whence the animals are called *semi-plantigrade*.

4. VIVERRIDÆ, or *Civet* tribe, in which the body is somewhat elongated, and the claws partly retractile; their habits are noc turnal, and many have a strong musky odour. The incisors are $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, false molars $\frac{3-3}{4-4}$, carnivorous teeth $\frac{1-1}{1-1}$, tubercular molars $\frac{2-2}{1-1}$. 5. MUSTELIDÆ, or *Weasel* tribe: distinguished by their long narrow bodies, and by their propensity to suck blood, rather than to devour flesh; their dentition is as follows: incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, false molars $\frac{2-2}{3-3}$ or $\frac{3-3}{3-3}$, carnivorous teeth $\frac{1-1}{1-1}$, tubercular molars $\frac{1-1}{1-1}$. The remainder of the terrestrial species of the order are *plantigrade*, applying the whole sole of the foot to the ground in walking. 6. MELIDÆ, or *Badger* tribe, resembling the Weasels in their dentition, but presenting a large blunt tubercle on the inside of the carnivorous tooth. 7. URSIDÆ, or *Bears;* the animals of this family are characterised by their robust figure and heavy gait, as well as by the adaptation of their teeth to a vegetable diet. Even the carnivorous tooth is small and tubercular, and the false molars frequently drop out with age. 8. CERCOLEPTIDÆ, or the *Kinkajous*, a small family of American animals, somewhat resembling the Bears in the character of their dentition, but possessing a long prehensile tail. 9. PHOCIDÆ, or *Seal* tribe; these are at once distinguished by the adaptation of their form to residence in the water, the body being elongated and tapering from the chest to the tail, the hinder limbs being directed backwards, so as to terminate the body, and the extremities being converted into paddles. The dentition is variable in the different genera, but it differs completely from that of the other Carnivora; the teeth are especially formed for laying hold of the slippery prey on which these animals feed, and for dividing the body of the fish they devour into large portions.

186. The FELIDÆ are all essentially carnivorous; never touching vegetable food, except when domesticated, and even then only in small quantity. They will rarely devour any flesh which they have not themselves killed, or which is undergoing decomposition. They are, consequently, of all Mammalia, the most destructive in their propensities; and their bodily powers are in admirable accordance with their instincts. Their frame is vigorous, but agile,—the limbs short,—the joints

well-knit, but supple,—and every motion is easy, free, and graceful. There is no superfluous flesh; but the whole seems composed of bone, nerve, muscle, and sinew. They are surpassed in fleetness by many of the animals on which they prey, —these being provided with longer limbs; but none of these approach them in the power of leaping and bounding. Their footfall is rendered noiseless, by the pads with which the under surface is provided. Their senses are for the most part very acute. Their sight is adapted for vision by night as well as by day; the sense of hearing is exquisite; that of smell also is in great perfection, though in this particular they are surpassed by the Canidæ; and the long whiskers are most acute organs of touch, which must be of the greatest value when the animal is stealing upon its prey at night, through a thicket or jungle. The tongue is furnished with rough horny papillæ, directed backwards; these serve a very important purpose in enabling the animal to scrape off the minute particles of flesh adherent to the bones of its prey. In the moderate degree in which this peculiar conformation exists in the tongue of the common Cat, it is familiar to every one; in the Lion and Tiger, however, the roughness is so great, that one stroke of the tongue would lick off the skin from a man's hand. As already stated (§ 15), the different species of this family for the most part bear a very close resemblance to one another, in general conformation, though differing widely in size; and it is chiefly by their variation in this last respect, that their habits are guided. Thus the Lion, and Tiger, the largest of the Felines, are confined to the ground; the Leopard, Panther, and various species of Tiger-Cats sometimes spring upon their prey from the branches of trees, sometimes from the ground; whilst the Wild Cats are almost exclusively arboreal, seeking their food amongst trees, and comparatively seldom frequenting the ground. Most of the Felidæ may be tamed, if early brought under the influence of Man; and they show considerable intelligence when domesticated. They are for the most part liable, however, to occasional outbreaks of ferocity, which show that their natural instincts are

repressed rather than subdued; and too much confidence, therefore, should not be placed in them.

187. Some species of this family are found in every quarter of the globe except Australia, where they are replaced by carnivorous Marsupials; it is of tropical climates alone, however, that the largest are inhabitants. The *Lion* is at present restricted to the interior wilds of Africa, to some of the districts of Arabia and Persia, to the country bordering the Euphrates, and to some parts of India. It is more disposed to exhibit *varieties*, than most other species of the family, except the Domestic Cat. Thus the Barbary breed, the Senegal breed, the Cape breed, the Bengal breed, and the Persian or Arabian breeds, all present slight differences from each other, in the development of the mane, and the colour of the fur; and a nearly maneless breed has lately been described as occurring in Guzerat; yet they all most probably belong to the same species. The Lion, too, is more easily domesticated than the Tiger; and shows a degree of generosity and nobleness of temper, which more approaches that of the Dog. The common appellation,—"king of the forest"—is misapplied to the Lion; for he frequents, not forests, but burning desert plains, and wide *karroos* covered only with shrubby vegetation, or interspersed with tracts of low brushwood. During the day he usually slumbers in his retreat; and as night sets in, he rouses from his lair and begins his prowl. The nocturnal tempests of rain and lightning, which in Southern Africa are of common occurrence, seem to be peculiarly congenial to him, and excite him to increased activity. His voice then mingles with the roar of the thunder, and adds to the confusion and terror of the beasts on which he preys, and upon which he now advances with less caution and with a bolder step. In general, however, he waits in ambush, or creeps insidiously towards his victim; and then springs on it with a tremendous bound, and terrific roar. Various extraordinary stories are related, of the degree in which the eye of Man, steadily fixed upon a Lion, can keep him at bay; yet this is no proof of want of courage; on the contrary, the Lion, when attacked, displays the utmost daring resolution. His strength is such, as to enable him to carry

off a large heifer or antelope, as easily as a cat carries off a rat. The muscles which raise the jaw are of enormous size; and those which support the head, as well as the *ligamentum nuchæ* which runs along the spinous processes of the vertebræ to the occiput (ANIM. PHYSIOL., § 29), are very highly developed.

188. The *Tiger* must be regarded as the *typical* species of the family; presenting, as it does, all the peculiarities of the group, most strongly marked. It is exclusively confined to the south-east of Asia, and to the larger islands of the Asiatic Archipelago; where its ravages are often terrific. It is equal in size to the Lion, but of a more elongated form, and is pre-eminently graceful in its movements; the head, also, is shorter and more rounded. Its body and tail are marked by bands of a dark colour; and these are much more constant (although the particular shade varies) than the mane and other peculiarities of the Lion. The presence of dark bands or patches on a tawny ground, may be regarded as very characteristic of the Felidæ in general; and this is another point in which there is a deficiency

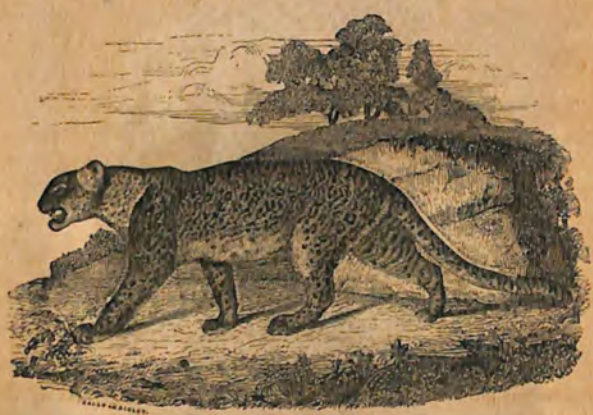

FIG. 101.—PANTHER.

in the Lion.—The *Leopard* and *Panther*, between which it is not easy to distinguish, are more widely spread through the tropical

portions of the Old World; being natives of Africa, India, and the Indian islands, as Ceylon, Sumatra, &c. They are very graceful and active animals; possessing bodies of great flexibility; and being able to bound, swim, climb trees, or crawl like a snake upon the ground, with nearly equal facility. They generally take refuge in trees when pursued; and occasionally spring upon their prey from its branches. The Monkeys and other small arboreal animals, as well as the terrestrial quadrupeds, fall a prey to them.—Several other species of Felines inhabit the East; but of these we shall only mention the *Cheetah* or Hunting Leopard (*Felis jubata*) · which departs, in many particulars, from

Fig. 102.—Hunting Leopard.

the general characters of the family. The foot, instead of being rounded, is long and narrow; its claws are but slightly retractile; and the body and limbs are longer and narrower than in the Leopard, with which it corresponds in size. This animal is a native of Africa and India; and in the latter country it has been long employed in hunting Deer, Antelopes, &c. In captivity,

it is familiar, gentle, and playful; and becomes greatly attached to those who feed or notice it. When carried out to the field, it is blinded ; and the hood is taken off when a Deer or Antelope separates itself from the herd. The Cheetah then crouches until it approaches its prey, and then bounds on it by a few vigorous springs. When once it has tasted the blood of its victim, its original nature breaks out, and it can with difficulty be drawn away by its keeper.

189. These animals are represented in America by the Puma, Jaguar, and other species. The *Puma* has been commonly termed the American lion, on account of its uniformity of colour, which is a silvery-fawn ; in its young state it is marked with blackish-brown streaks, but these disappear with the advance of age. Though the largest of the American Felines, it by no means equals the Lion in size and strength. It is extensively diffused through North and South America ; but it is more scarce than formerly, and its range is more contracted ; and as civilisation advances, it will be still further reduced. The Puma is very destructive to the native animals and cattle in its vicinity,

Fig. 103.—Jaguar.

but it seldom attacks man. The *Jaguar* may be regarded as the Panther of America ; but it is even more powerful, and almost rivals the Tiger of the Indian jungles. It swims and climbs

with equal ease; and preys not only on the larger domestic quadrupeds, and on the wild mammals, but also on birds, fish, and tortoises, and on the eggs of the turtle. It will not attack Man, however, unless hard pressed.—Several Tiger-Cats inhabit South America; of which the *Ocelot* is among the most beautiful. It is often exhibited in menageries, and is good-tempered and playful if kindly used. It inhabits the deep forests, living chiefly in trees, and preying upon small quadrupeds or birds, for which it lies in wait, concealed under the foliage.

190. The *Wild Cat* is the only species of this family that can

Fig. 104.—Wild Cat.

be properly said to belong to our own country,—the Domestic Cat having been probably introduced at a very remote period. In earlier times, when woods and forests covered many parts of the kingdom which are now reclaimed and devoted to agriculture, the Wild Cat was much more generally distributed; but it is now confined to Scotland, some of the woods in the North of England, the woody mountains of Wales, and some parts of Ireland. Their favourite places of resort are the most inaccessible mountainous woods; where they retreat not only to hollow trees, or the depth of thickets, but to concealed fissures of rocks, in which they seek their safety and repose, and bring forth and rear their young. Hares, leverets, rabbits and birds

are its chief prey. The Wild Cat is found throughout all those countries of Europe, in which extensive forests exist; especially in Germany, and in the wooded portions of Russia, Hungary, and Northern Asia. It was at one time supposed, that the Domestic Cat is a descendant of this wild species; but the points of difference between them are such, as to render this idea very improbable; especially as the specimens, not unfrequently to be met with, of Domestic Cats which have gone back to their original wild life in the woods, do not exhibit any tendency to return to this form. There is a species of Wild Cat in Egypt, which corresponds with the race that seems to have been domesticated by the ancient Egyptians; of this race, specimens are still preserved in the mummy state. To this species, our own Domestic Cat has been referred by some naturalists; whilst others think that the origin of the race has yet to be discovered.*

191. The *Lynxes* differ slightly from the other Felines, in having the ears tufted with pencils of hairs, in the shortness of

Fig. 105.—Common Lynx.

the tail, and in the greater elevation of the body at the haunches. They are less courageous, as well as less domesticable, than the other Felines; and show a sullen and suspicious disposition. There are several species; of which some inhabit Europe, others Asia and Africa, and others America. They live upon small

* See Bell's British Quadrupeds, p. 185.

quadrupeds and birds, pursuing the latter to the tops of trees; some of them also resort to the water, to feed on fishes; and it is said that they have less dislike to carrion than the other Felidæ.

192. The family CANIDÆ, or *Dog* tribe, will not detain us long; since the number of distinct forms which it contains (according to the classification here adopted) is small; and several of the most interesting questions relating to them have been already discussed. If the idea put forwards in the Introductory Chapter (§ 14),—that the Dog and Wolf are of the same species,—should prove correct, we shall be of course led to regard the *Wolf* as the type of the family. This animal, as is well known, is no longer an inhabitant of our own country; having been completely extirpated from England many centuries ago, and more recently from Scotland and Ireland. The last record of their existence in England in any formidable numbers, was in the year 1281; but it is stated, that in 1577, they were very destructive to the flocks in Scotland; and in Ireland they were exterminated only at the beginning of the last century. The Wolf is still spread, however, through almost every part of the Continent of Europe, and Northern Asia; especially in mountain and forest districts, and where the population is scanty. It is extremely destructive to domesticated animals in the districts where it abounds; as is shown by the following official report made to the Russian Government, of the slaughter committed by the Wolves of the district of Livonia,—a tract about 250 miles long by 150 broad,—in the year1822. Horses, 1841; cattle, 1807; calves, 733; sheep, 15,182; lambs, 726; goats, 2545; kids, 183; swine, 4190; young pigs, 312; dogs, 703; geese, 673; fowls, 1243. It seldom attacks Man, however, except when pressed by hunger, and when associated with others of its kind. The general aspect of the Wolf is well known. Its frame is robust but gaunt, its gait skulking and irresolute, its physiognomy has a wild and sinister expression, and its character is marked by mingled ferocity, cunning, and cowardice. It is habitually cautious and suspicious, so that it is not easy to take it in traps; and when pursued it rushes along with great velocity; but when brought to bay, it defends itself with the

greatest determination. Its strength is very great, especially in the muscles of the head, neck, and shoulders; and its bite very severe. Its capability of being domesticated has been already noticed. Several distinct species of Wolves are found in different parts of the globe, especially in America; they vary somewhat in size and power, and in the degree of predominance of the cunning or of the ferocity of their characters; but their general habits are much the same as those of the common Wolf.

193. Of the *Dog*, it is unnecessary (after what has been already said) to give any Zoological description; an account of its varieties or breeds would not fall within the province of this work; and instances of its sagacity and reasoning power will be more properly given in the last division of this Treatise. We shall therefore pass on to notice briefly some other species of this family.—The *Jackal* is somewhat intermediate in its character between the Wolf and the Fox; resembling the former in its habits, and the latter in its appearance. It associates in troops, which lie concealed in holes during the day, and which come forth at night with dismal shrieks, attacking any animals they are capable of overcoming. It feeds greedily also upon carrion and offal of every description; and is thus of service in removing what has been left by other beasts of prey. The Common Jackal has a range from the North of Africa, through Syria, Persia, and the greater part of India; and other species are found in the middle and South of Africa, where they may be considered as replacing the Wolf.—The *Fox* is chiefly characterised by its sharp muzzle and long bushy tail; as well as by the cunning of its character, which has passed into a proverb. The common species is an inhabitant of most parts of Europe, as well as of Britain; and extends also into Northern Asia. Its senses are extremely acute, so as alike to inform it of the neighbourhood of its prey, and to warn it of the approach of danger. It usually remains concealed during the day, in a burrow which it has either made for itself, or usurped; and ventures abroad chiefly at night, with stealthy movements, in search of food. Though slightly made, the Fox has great muscular vigour, and bites with much severity. Even when taken at a very

early age, it is never properly domesticated; and adults, when placed in confinement, show great ferocity and soon die. It is

FIG. 106.—COMMON FOX.

to its power of endurance and its great speed, as well as to the cunning which dictates various expedients for escape, that the chase of this animal owes its exciting character; and were it not for the artificial preservation of the race, for the purpose of the sportsman, it would long since have been extirpated from this

FIG. 107.—ARCTIC FOX.

country. Among the most common of its expedients for escape, is feigning death; which is done by several other animals

also. Numerous other species of Fox exist in the Old and New Worlds; of these, however, we shall only stop to notice the *Arctic Fox*, which is confined to the high northern latitudes. The hair of this animal, in summer, is of a dusky ash or leaden hue; but in winter it assumes a pure white. The fur also becomes fuller and thicker, and even deeply covers the soles of the feet.—The *Lycaon pictus*, or Cape Hunting-dog, is the last species of this family, to which we shall advert. It forms a complete transition to the next family, from its strong resem-

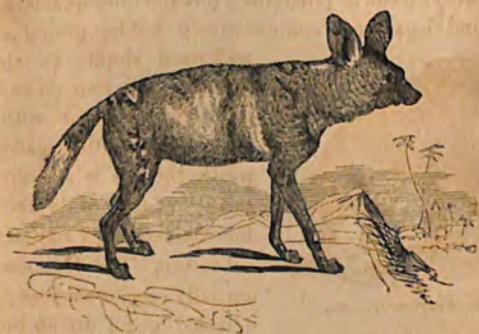

Fig. 103.—Lycaon Pictus.

blance to the *Hyæna*, not only in general aspect, but also in possessing but four toes on its fore and hind-feet. It agrees with the Canidæ, however, in its dentition and habits; and may be regarded as just such an aberrant form of that family, as we might expect to find making a transition to the next. It is a wild, fleet, and savage animal, hunting in packs by day as well as by night; and advancing by stealth on prey, which it will not venture to attack openly.

194. Family Hyænidæ. The *Hyænas* and their allies, placed by some zoologists with the *Dogs*, and by others with the *Civets*, to both of which families they are evidently related, are well worthy of occupying an independent position. The molar teeth of these animals are as follows; false molars $\frac{3-3}{3-3}$, carnivorous teeth $\frac{1-1}{1-1}$, tubercular molars $\frac{1-1}{0-0}$. Notwithstanding the difference

in their dentition, however, they are closely related in many points to the Civets, and are connected with them by a remarkable genus to be presently noticed. The skull of the Hyæna is short, and remarkable for its solidity; the muzzle also is short; and the temporal muscles, which raise the lower jaw, together with those of the neck, are enormously developed. The vertebræ of the neck, in adult animals, are often found to be united together; as if for the purpose of resisting the most violent strains. The general form of the body is very peculiar. The neck, chest, and shoulders are extremely powerful; but the hind-quarters are low, and the hind legs seem comparatively feeble, giving a kind of awkward shuffle to the pace. The toes are four on each foot; and are furnished with blunt, stout, unretractile claws. Beneath the tail is a deep pouch, analogous to that of the Civets, but not secreting a similar odorous substance. The Hyænas are essentially carrion-feeders; and are destined to fill up an important station in the economy of nature. They cleanse the earth of the decaying carcasses of the larger beasts, whose remains, if not speedily removed, would infect the atmosphere with pestilential effluvia. They devour, too, the remains left by other beasts of prey; being specially enabled to do so by the enormous strength of their jaws, and by the peculiar conformation of their teeth, which are adapted rather for crushing hard substances, than for dividing animal flesh; and these, by their combined power, enable them to crunch even the largest bones, so as to extract from them the nutritious matter they contain. The Hyænas will seize upon living animals also; but seldom attack Man openly, except in self-defence. Their haunts by day are dens and caves, gloomy rocks, and the ruins of towns and sepulchral monuments of antiquity. As darkness sets in, these fierce beasts emerge from their lair, and prowl in search of their prey, with menacing teeth and glaring eyes. Notwithstanding the ferocity of its dis-

FIG. 109.—SPOTTED HYÆNA.

position, the Hyæna is easily tameable when young; and shows much of the attachment to its master, which is characteristic of the Dog. The Hyæna is confined to Africa and Asia; the striped species is a native of southern and central Asia, and of northern Africa; the spotted species, and another that bears more resemblance to the striped, are found in Southern Africa, and are great pests to the colonists.—The *Proteles* or *Aard-Wolf*

Fig. 110.—Proteles Lalandi.

(earth-wolf) of the Cape of Good Hope, is evidently the connecting link between the Hyænas and the Civets; resembling the former in its general contour and manners, though of inferior size and strength; and having more of the lengthened head and pointed muzzle of the latter. There are five toes on the hind-feet, but only four on the fore-feet. In this respect therefore the *Proteles* resembles the Dogs, but its dentition is like that of the Hyænas. This animal is very destructive to the young lambs; and is said to attack the massive fatty protuberance on the tails of the African sheep.

195. Of the family Viverridæ, we shall first notice one of the typical genera, the *Viverra* or *Civet;* which is characterised by the possession of a double pouch, that secretes a fatty substance of a strong musky odour, used as a perfume; by the half-retractile power of the claws; and by the pupil of the eye being circular during the day, instead of being contracted into a vertical

line as in the Cat tribe. The general aspect of this animal is shown in the accompanying figure; it is wild and savage in

Fig. 111.—Civet

its character, preying upon birds, reptiles, and small mammals, which it takes by surprise; it exhibits great energy and bodily activity; and, though the young are easily tamed, adults can never be reconciled to captivity. The best known species is peculiar to North Africa, and is especially common in Abyssinia; but others are found in different parts of the warmer regions of the Old World. The *Genets*, of which one species inhabits the South of Europe, present many points of resemblance to the Feline tribe, in manners, as well as in anatomical characters and general aspect; their claws are completely retractile. And the connection of the two families is still more closely established by certain other species, which have been classed with the Cats. On the other hand, the *Ichneumon* of Egypt,—in the form of its long agile body, its short limbs, semi-plantigrade feet, small glowing eyes, pointed nose,—as well as in its bold, active, sanguinary, unrelenting disposition,—and in the habits which result from this,—bears a very close resemblance to the *Weasel* tribe. It glides towards its prey with a snake-like movement, and then darts suddenly upon it. It feeds upon birds, and small reptiles, and mammals; also upon eggs: and it is particularly serviceable

in restraining the multiplication of the Crocodile, by devouring its eggs, and also the young Crocodiles when newly hatched. The Ichneumon is easily domesticated, and seems to form an attachment to its place of residence; it is not unfrequently kept tame in the countries of which it is a native, for the purpose of clearing the houses of mice, rats, &c. One species of this family, the *Bassaris astuta*, is found in Mexico; the remainder are all inhabitants of the Old World.

196. The animals of the family MUSTELIDÆ are smaller, for the most part, than those of the Feline family, and consequently less formidable, as far as man is concerned; but they are equally sanguinary in their propensities and habits, and are equally destructive to the races on which they are appointed to prey,—the smaller mammals, with birds, reptiles, and fishes. From the shortness of the legs, the elongation, slenderness, and flexibility of their bodies, and their gliding movements, they have been not unaptly called *Vermiform* (worm-like) Carnivora. They are silent, cautious, and creeping; and attack their prey with unflinching resolution. Having seized their victim, they never let go their hold. They generally aim at the neck below the ear, where they pierce the large blood-vessels with their teeth; or they fix upon the back of the head, and drive their teeth through the skull. Few quadrupeds surpass them in agility and address; they bound and spring with vigour, and climb trees with astonishing dexterity, traversing the branches with a rapid gliding motion. Their habits are nocturnal; and they pass the greatest part of the day in their retreats, which are the hollows of decayed trees, burrows, holes in walls, &c. With the approach of night, they rouse from their slumbers, and, greedy for blood, begin their prowl. Most of these animals have a strong odour; which is extremely offensive in some species. Several of the most costly and beautiful furs are obtained from this family; among them those of the Sable and Ermine.—The *Pole-cat*, *Stoat*, *Ferret*, *Marten*, and *Weasel*, are British representatives of this family: they strongly resemble each other in structure and habits; and all present the characters which have been just detailed. The Stoat is of the same species with the

Ermine; the latter being the Stoat in its winter dress. In our own climate this change is not complete; but in more northern

Fig. 112.—Marten.

regions, the whole body becomes white, except the tip of the tail, which remains black. The *Pine-Marten* of North America, the *Sable* of Northern Asia, and the *Zorilla* of Southern Africa, are also typical species, nearly allied to these. The *Skunk* is remarkable for the intolerable odour of the secretion from its glandular pouches; which neither man nor dog can endure. This fluid it has the power of ejecting upon its pursuers, when hard pressed; and it serves as the most complete means of defence, a single drop being enough to produce nausea, and a sense of suffocation. Of this genus, four or five species are known; which are all American.

197. A somewhat aberrant form of the Weasel tribe, is the *Otter*, an aquatic animal, which conducts us, in its general conformation and habits, towards the Seals. Many of the true Weasels resort occasionally to the water in quest of food; and in those species, the form of the body approaches that of the Otter. In their dentition, the Otters differ but little from the Polecats, Martens, and Skunks; the false molars being $\frac{3-3}{3-3}$, the carnivorous teeth $\frac{1-1}{1-1}$, and the tuberculated molars $\frac{1-1}{1-1}$. The body is elongated and flattened in its form; the limbs short and stout; the toes (five on each foot) are webbed and spreading; the soles are naked. The tail is long, stout and muscular at its base,

tapering towards the extremity, and somewhat flattened horizontally. The fur is close, short, and fine; consisting of a thick woolly undercoat, and an upper layer of smooth glossy hairs. The head is broad and flat; the ears are very small and close to the skull; and the eyes are provided with a *nictitating membrane* (or third half-transparent eyelid, like that of Birds) as a defence to their surface. All these characters plainly indicate the adaptation of the animal to an aquatic residence; and an acquaintance with its habits shows their purpose. On land, the movements of the Otter are by no means free or rapid; but it makes to the water when attacked, and there it swims with the greatest facility. Its motions in the water are remarkably graceful; it swims at every depth with great rapidity, every now and then coming up to the surface to take breath, and then diving like a shot, following its prey through every turn with the greatest perseverance, until its exhausted victim can no longer escape the jaws of its rapacious foe. Its food naturally consists entirely of the Fish which it thus captures; and in pursuit of them it will even descend along rivers to the sea: but when fish are scarce, it will assume the habits of the Stoats and Weasels, resorting far inland to the neighbourhood of the farm-yard, and attacking lambs, sucking-pigs, and poultry. The Otter does not excavate a burrow for itself, as some have affirmed; but avails itself of any convenient hollow for its residence,—such as those beneath the overhanging roots of trees which grow on the banks of rivers. It is capable of being domesticated, when taken young; and may be used to catch fish for its master. Bishop Heber mentions that the Indian fishermen keep the Asiatic species for this purpose, and that they find them of great use in fishing; and justly remarks that "the simple Hindoo here shows a better taste and judgment, than half the Otter-hunting and Badger-baiting gentry of England." There is a species of Otter, found on the North-west coast of America, and on the opposite coast of Asia, which frequents the sea-shore almost exclusively, and bears a still stronger resemblance to the Seals, than does the common species. Its tail is shorter; and its hind-feet, which form very broad and powerful paddles, are directed far back. The teeth

are evidently formed for bruising hard substances; and the animal probably lives upon Mollusks and Crustacea, as well as upon Fish.

198. The family of the MELIDÆ, or Badgers, the first of the *Plantigrade* section of the Carnivora, includes but few species, some of which, however, are evidently allied to the Weasels, whilst others approach the aberrant members of the family of Bears. The *Badger*, which is almost completely plantigrade in

FIG. 107.—COMMON BADGER.

its walk, presents a strong resemblance to some of the Ursidæ in its general aspect; but is separated from that family by an important distinction. All the Bears and their allies have at least two tuberculated molars; whilst the Badger has but one. This, however, is of very large size in the upper jaw, and is adapted for the mastication of vegetable aliment. Its food consists of roots, earth-nuts, fruits, and eggs, as well as of small mammals; and it is said also to attack the nests of the wild-bee, plundering the store of honey, and also devouring the larvæ, without dread of the stings of the enraged insects, which cannot penetrate its tough skin. Its favourite haunts are obscure and gloomy; it retires to the deepest recesses of woods, or to thick coppices on the side of hills; and there, with its long and power-

ful claws, it digs for itself a deep and well-formed domicile, consisting of several chambers, the inner one of which is of a circular form, and is comfortably lined with grass and hay. Here the animal spends the day in repose, moving out only at night in search of food. The Badger possesses great muscular power, especially in the jaws; and the firmness of the grasp which it can take with its teeth is increased by a peculiar conformation of the joint,—the *condyle*, or articulating head of the lower jaw, being received deeply into the *glenoid* cavity, (ANIM. PHYSIOL., § 623), which bends over it before and behind, so as to retain it in its place, even when all the muscles and ligaments have been removed. It may be easily tamed, if taken young; and shows great attachment to Man. The common species is still found in some parts of England and Scotland, and in almost every other country in Europe, though it is nowhere very abundant; it also extends over Middle Asia, and is said to be very common in China, where it is used as food. There is a distinct species in India, and another in North America; but their habits seem to bear a close resemblance to those of the one best known. The *Ratels* or *Honey Badgers*, of which the best known species is an inhabitant of the Cape, are thick-set, clumsy animals, nearly resembling the Badgers. The Cape Ratel is celebrated for the destruction which it makes amongst the nests of the wild-bees, to the honey of which it is very partial. This family also includes several other animals, which connect it with neighbouring groups, and manifest its peculiarities in a less striking degree. Among these are the *Gluttons* of the northern regions of the Old and New World; which are evidently intermediate between the Polecat and the Badger, agreeing with the former in their dentition, but having more of the general figure and aspect of the latter. They are slow and comparatively deficient in agility; but they are very persevering and determined, as well as cunning. They often proceed at a steady pace for miles, hunting out weak or dying animals, and stealing unawares upon hares, marmots, birds, &c. They are said to surprise the larger animals, such as the Reindeer and the Elk, as they lie asleep, or to mount on the branches of trees and spring down upon them as they pass below,

destroying them afterwards by tearing the neck and throat in the same manner as the Weasel. The old accounts of the extraordinary voracity of the Glutton, or *Wolverine*, as it is sometimes more appropriately called, are certainly to be regarded to a very great extent as fabulous, and although, like the Polecats, which it so much resembles in some respects, it is probably of a bloodthirsty disposition, the animal does not appear to be more gluttonously disposed than its allies. It fights very resolutely; and its great strength renders it more than a match for a single Dog of its own size.

199. The animals of the family URSIDÆ are, of all the Carnivora, those which are most omnivorous in their diet,—some of them living almost entirely upon vegetable food,—and nearly all being capable of supporting themselves upon it. Most of them are expert climbers; they conceal themselves in caves, in holes of the earth, and in hollow trees; and in such retreats they usually pass the winter in a state bordering on torpidity, and there the female brings forth her young. The characters of the family are most strongly marked in the animals of the genus *Ursus* or *Bear;* which are distinguished by their ponderous bulk, massive limbs, and heavy gait. They are completely plantigrade in their walk, and can rear themselves without difficulty on their hind-legs. They have large claws, which are adapted for digging, and which are powerful weapons of attack and defence; these are not retractile. Bears are for the most part unsocial animals, frequenting the recesses of mountains and caverns, and the depths of the forests. They are expert climbers, ascending trees and rocks with great dexterity. The food of the different species varies in some degree; being almost exclusively vegetable in some species, such as the American Black Bear, which will not touch animal flesh, if vegetable aliment can be obtained; whilst it is almost as exclusively animal in others, such as the Polar Bear. Even the most carnivorous of them, however, will seldom attack Man, unless provoked to do so by aggression, or strongly incited by hunger; but when attacked, they become very formidable opponents, displaying greater activity and address than might be expected from their heavy clumsy figures.

Various species of Bear are diffused through Europe, Asia, and America; but Africa is almost (although not entirely, as has been supposed,) destitute of them. The *Brown Bear* is the species best known; it inhabits the mountainous parts of Europe, from the Arctic circle to the Alps and Pyrenees, and also the north of Asia and Siberia; it was formerly a tenant of the hills and forests of our own island, whence it was exported to Rome, to be a partaker in the cruel fights exhibited in the Circus. It has been long, however, exterminated from Britain; the year 1057 being the date of the latest mention of it in Scotland, where, like the Wolf, it seems to have lingered after being driven from England. The *Black Bear* is very widely diffused through

Fig. 114.—American Black Bear.

North America, from the Arctic Sea, to its southern extremity; and its skin was at one time a considerable article of commerce. One of the largest known species, is the *Grisly Bear* of North America, which is everywhere dreaded for its strength and ferocity, and which even attacks and vanquishes the huge Bison. And the *Polar Bear*, whose residence is amidst the snow and ice of the arctic regions, seems to attain a yet larger size,—the length of one killed in Captain Lyon's expedition being stated at eight feet and a half, and its weight at 1600 lbs. This formidable animal feeds chiefly upon Seals; in pursuit of which it

will not only traverse vast fields of ice, but will also swim for considerable distances through the sea. It will devour the remains of Fishes, Cetacea, and other marine animals; and has been even seen to dive after and capture living Fish. In summer, the Polar Bear devours mountain-berries; and does not reject even sea-weeds and marsh-plants. Of the devotion of the female Polar Bear to her young, and of her courage in their defence, many instances are recorded in the histories of arctic voyages.

We have now to notice certain aberrant genera of this family; in which the characters of the group are less prominently displayed. The *Raccoon* differs from the Bears in its dentition; having only 6 instead of 7 molars in the lower jaw; and the carnivorous tooth being formed like the posterior molars, and ill suited to cutting flesh. In size, it equals a common Fox; it has a stout body with moderate limbs, and a semi-plantigrade walk; the toes are five on each foot, and armed with sharp claws; the muzzle is sharp, the nose tapering beyond the lips, and flexible; the tail is somewhat bushy. The Raccoon is nocturnal in its habits, sleeping by day in its hole, and prowling at night in search of food. It frequents the margins of swamps and rivers, and the sea-shore; and preys upon small animals, birds, eggs, insects, and shell-fish, with the addition of roots and sweet succulent vegetables. Its dexterity in opening Oysters has been particularly noticed. Its gait on the ground consists of a series of bounds, reminding us of the Lemurs, but without their grace or agility; it climbs trees readily, in the same manner as the Bear. When taken young, this animal is easily tamed, and its habits are gentle and playful; but it is at the same time capricious and easily offended, and seldom forgives its enemy.—The *Coati* is distinguished by the elongation of its snout, to which its scientific name *Nasua* refers; to this character an approach was pointed out in the Raccoon. The snout is a sort of short flexible proboscis, at the extremity of which the nostrils open; the animal turns it about in various directions when in search of food, and uses it to root up the earth in quest of worms and insects. In its general characters and habits, it strongly resembles the Raccoon; and like it is confined to the New World.

These genera are represented in the Old World by the *Ailurus* or *Panda* (Fig. 115), which is an inhabitant of the Himalayan ridge; it is evidently adapted to a cold climate by its thick covering of fur, which consists of a woolly undercoat, with long soft hair overlying it.

Fig. 115.—Ailurus or Panda.

200. The Cercoleptidæ, or *Kinkajous*, form a small group nearly allied to the aberrant Ursidæ. They are of small size, and inhabit the tropical parts of America, feeding upon small birds and mammalia, insects and fruit, in search of which they climb trees with great agility.

201. The animals of the family Phocidæ, or *Seal* tribe, which form the order Pinnipedia of many modern Zoologists, are, of all four-limbed Mammalia, those which display the most complete adaptation to residence in the water. We have seen an approach to this in the *Otters*, especially in the marine species (§ 197); but it is carried much further in the Seals. The body is elongated and conical, tapering from the chest to the tail,—the pelvis being so narrow as not to interrupt the gradual

Fig. 116.—Seal.

decrease. The spine is provided with strong muscles, which bend it with considerable force; and this movement is of great

assistance in the propulsion of the body. The limbs are converted into oars or paddles. The anterior pair have the arm and fore-arm so short, that little more than the paw advances from the body; in this the bones of the fingers are separate, but they are inclosed in a skin common to all of them, which extends to their tips, so that they are externally marked only by the claws which terminate them. The hinder limbs are directed backwards, so as almost to seem like a continuation of the body; the thigh and leg are very short, and the foot is formed on the same plan as the fore-paw,—the toes being in contact, however, and the web folded, when it is not in use as a paddle, but being spread out into a broad surface when the animal is swimming through the water. Between these paddles is the short and compressed tail. On land, or on masses of ice, the movements of the Seal are awkward, its under-side resting on the ground, and its body being forced onward by the action of the fore-limbs only, whilst the hinder ones are dragged after it. But it swims with great rapidity and ease; and, by a peculiar arrangement of its blood-vessels, analogous to that which exists in the Whale-tribe, (ANIM. PHYSIOL., § 265), it can remain under water for a considerable time. The head is of a rounded form, and is furnished with long stiff whiskers; the nostrils are provided with a valve, which can be closed at will, so as to keep out the water; a similar valve exists in the orifices of the ears; and the clothing of the body consists of stiff glossy hairs, very closely set against the skin. The form of the teeth varies considerably in the different genera of this family; but in all they are adapted rather to *hold* the slippery prey on which these animals feed, than to *cut* or to *crush* what offers much

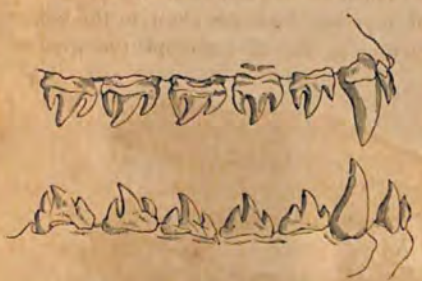

FIG. 117.—TEETH OF STERRINCK.

resistance. Of this *prehensile* character, the accompanying figure affords a good illustration. The incisors are either $\frac{6}{4}$ or $\frac{4}{4}$; the canines are always present, and are large and strong; the molars are usually from 20 to 24 in number, that is, either 5 or 6 on either side of each jaw.

202. A considerable number of species of *Seal* exist; all of them inhabiting either the temperate or the frigid regions of the globe. At least four are known to visit the shores of Britain. The *Common Seal* (Fig. 116) is from four to five feet long; its physiognomy is mild and expressive, like that of a Dog; it is readily domesticated, and shows great intelligence and attachment to Man. The *Grey Seal*, on the other hand, which sometimes attains the length of twelve feet, is much less intelligent, and cannot be tamed; it shows considerable resolution, and even ferocity, when attacked. The *Greenland*, or *Harp Seal*, is remarkable for the changes of colour which it undergoes in the course of its advance towards maturity; the markings of the body are so distinct in different years, that the precise age of the animal may be known by them. The immature species has been regarded (as in many other instances, § 18), as distinct from the adult, by those who were not acquainted with its history. The *Elephant Seal* of the South Seas is the largest known species; its length being from 20 to 30 feet; and its girth at the largest part of the body being from 15 to 18 feet. A full-grown male will yield 70 gallons of oil. This seal lives in troops, which migrate towards the tropic in winter, and return southwards in summer. It is much sought after, on account of the large quantity of oil which it yields; and also for the skin, which is extensively used in harness, on account of its strength and thickness. It is a very inert animal, not being easily alarmed, and making little defence when attacked. Its food appears to consist in part of sea-weeds and cuttle-fish; the

Fig. 118.—Teeth of Elephant-Seal.

remains of both having been found in its stomach. The name of Elephant Seal is given to it, in part from the large size of its tusk-like canines; and in part from the prolongation of its snout into a kind of proboscis.—Several species of Seal are known under the names of Sea-Lion, Sea-Bear, &c. One of these, the *Ursal*, an inhabitant of the shores of the North Pacific Ocean, is represented in the accompanying figure. It is said to be one of the most pugnacious and ferocious of the whole tribe. There is a remarkable disproportion in the number of the sexes in this species; each family consisting of but one male with a crowd of females. If one family encroaches on the station of another, a general fight is the consequence; and Man, if he approach within their range, is by no means safe from their attacks. The *Fur Seal*, which is nearly allied to this, is an inhabitant of the Southern Pacific; it was formerly very abundant in certain localities, so that for a period of fifty years, not less than 1,200,000 skins were annually obtained from a single

Fig. 119.—The Ursal.

island; but its numbers have been much thinned by this excessive destruction.

203. A very aberrant form of this family is presented by the

genus *Trichecus*, of which only one species is known, the Walrus, Morse, or Sea-Cow.* In general form, as well as in habits, the Walrus resembles the larger species of Seal; but it differs from them entirely in dentition. Its chief peculiarity consists in the enormous development of the canine teeth of the upper jaw, which are from 18 to 24 inches in length, stout and solid; with large roots, of which the sockets project considerably, giving a swollen aspect to the face, which is increased by the thickness of the lips. These tusks are instruments of defence and of progression; and are also very serviceable to the animal in obtaining its food. It uses them with great effect in defending itself from the attacks of the Polar Bear; it makes use of them, in climbing up icebergs and the sides of rocks; and it employs them to tear up the long wreaths of sea-weed, which constitute a great part of its food. In the lower jaw there are no incisors or canines; and the jaw itself is narrow in front, so as to fit in between the large canines of the upper. The Walrus is pursued for the sake of its oil and tusks. It inhabits the arctic regions of both hemispheres; but is much less abundant than formerly.

204. The animals of this family are of the greatest use to the natives of the countries near which they abound; the following account of the various purposes, to which the Seal is applied by the Greenlanders, is given by Crantz, a Danish traveller. "Its flesh supplies them with their most palatable and substantial food; the fat furnishes them with oil for lamplight, chamber and kitchen fire; and whoever sees their habitations presently finds that, even if they had superfluity of wood, it would not be of use,—they can use nothing but oil in them. They also mollify their dry food, mostly fish, with oil; and finally they barter it for all kinds of necessaries with the factors. They can sew better with fibres of the seals' sinews than with thread or silk; of the skins of the entrails they make window-curtains for their tents, and shirts; part of the bladder they use as a float to their harpoons; and they make oil-flasks of the stomach. Neither is the blood wasted; but is boiled up

* It is now generally regarded as the type of a distinct family, the TRICHECIDÆ.

with other ingredients and eaten as soup. Of the skin of the seal they stand in the greatest need; because they must cover with seal-skins both the large and small boats, in which they travel and seek their provisions. They must also cut out of them their thongs and straps, and cover their tents with them, without which they could not subsist in summer. No man, therefore, can pass for a right Greenlander, who cannot catch seals. This is the ultimate end they aspire at, in all their device and labour from their childhood, up."

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205. There are some points of much interest, in the Geographical distribution of the Carnivora at present inhabiting the globe; as well as in the Geological distribution of the fossil remains, which indicate the races that existed in its several quarters, at former epochs. We cannot but be struck, when we consider the distribution of the typical family,—the FELIDÆ,—with their almost entire restriction to the tropical regions, and to the countries bordering on them; and with their consequent absence from Europe, and from the northern parts of Asia and America,—the comparatively small and feeble *Wild Cat* and the *Lynx* being the only representatives of the *Lions, Tigers, Panthers*, &c., of the tropics.—The same may be said of the family VIVERRIDÆ; of which the *Genet* is the only European representative, whilst the tropical regions contain many species, and the HYÆNIDÆ are confined to the warmer regions. On the other hand, the CANIDÆ are pretty generally distributed, whilst the MUSTELIDÆ are more abundant in cold and temperate climates, and the PHOCIDÆ are almost peculiar to the colder regions; the URSIDÆ and their allies are distributed everywhere, though they are now being gradually expelled from Europe and North America by the increasing human population.

206. Now there is abundant evidence,—derived from the fossil remains which occur in the newer *tertiary* strata (those that lie above the chalk), in gravel beds, and in caves,—that the larger *Feline* and *Hyænine* animals were formerly distributed

much more extensively;—that Lions and Tigers, of greater bulk than any at present existing, formerly roamed over the plains, and inhabited the jungles of Europe, and even of our own country; and that gigantic Hyænas and enormous Bears dwelt in the caves, which occur so frequently in our limestone rocks, dragging thither the carcasses of the animals they had slaughtered, and prowling about at night, with glaring eyes, and savage howls, in search of prey.* In many of these caves are now found vast heaps of bones of the animals thus destroyed, which must have accumulated during many years; together with the bones of the rapacious beasts which had their dwelling there; and it is a remarkable proof that these caves *really were* the dens of Hyænas, and that the collections of bones found in them were not merely washed into their entrances by some great convulsion which swept these races from this part of our globe,—that many of the bones of the Oxen, Antelopes, Deer, &c., which accompany them, bear the distinct marks of the Hyæna's teeth; and that the fossilised excrements of these last animals (which, like those of other Carnivora, are nearly white, consisting of little else than bone-earth,) have been clearly recognised. The existence of these gigantic Carnivora in what are now the temperate regions of the globe, seems clearly to indicate that the climate of these parts must have been formerly much warmer than at present; a conclusion which is confirmed by many other circumstances. (See Treatise on GEOLOGY). It is further interesting to remark, that as, at the present time, we only find the larger Carnivora existing in countries inhabited by large species of Herbivorous quadrupeds, on which they may prey, so, in former epochs, we never find the one set of races present without the other;—the Herbivorous to supply the Carnivora with food,—the Carnivora to restrain the otherwise excessive multiplication of the Herbivora, and to remove their decomposing remains from the surface of the earth.

* In a fissure recently laid open on Durdham Down, near Bristol, are found, besides numerous other remains, teeth of Hyænas, as much surpassing in size those of the largest Tiger now existing, as these last exceed those of the largest Hyæna.

ROYAL ASIATIC SOCIETY OF THE BOMBAY BRANCH

Order VI.—CETACEA.

207. This order, in regard to the *number of species* included in it, ranks nearly the lowest among the orders of Mammalia; but in regard to the *bulk of the individuals* which it contains, it far surpasses every other tribe of animals at present existing, being only rivalled by some of the gigantic Lizards of former epochs. No terrestrial quadruped, not even the Elephant and Hippopotamus, can be compared to the Whale; and even the smallest species, the Dolphins and Porpoises, much surpass the average size of land animals. As already mentioned (§ 24), the form of the animals of the Whale tribe bears so strong a resemblance to that of Fishes, that most of the ancient Zoologists, and even some modern ones, placed them in the same class; and they are still spoken of as "fish" in common parlance, notwithstanding that a knowledge of their internal structure has shown that they are, in every essential respect, Mammals.

208. The modifications in the form of the body, which have been pointed out as adapting the Seals for aquatic progression, are here carried still further. The body is still more lengthened,

Fig. 120.—Tail-fin of Whale.

the tapering of its hinder portion still more gradual, and the anterior extremities still more exclusively adapted for propulsion

in water. But there is a marked difference in the arrangement of the posterior instruments of propulsion; for the pelvis and hinder extremities are here entirely wanting (or, at least, only rudiments of them can be discovered), and the tail is expanded horizontally, so as to present a large surface for striking the water. In some of the larger species, the breadth of this tail-fin is 20 feet, and its surface not less than 100 square feet. The force with which it strikes the water is enormous, the muscles by which it is moved being of prodigious size. The greatest rapidity of motion is produced, when its strokes are alternately upwards and downwards; but the more ordinary progression of the animals is accomplished by an oblique movement of the tail downwards and laterally, first to one side and then to the other; much in the same manner as a boat is propelled by sculling. The vertical motion of the tail is most employed, when the animal desires to come to the surface to breathe.—The paddles or swimming paws are comparatively short; but, as the enormous development of the head in the true Whales causes them to be situated near the centre of gravity of the whole mass, they act with considerable power. They contain the same bones as the anterior extremities of other Mammals; but they are more consolidated together than in any of the orders we have yet considered; and there is but little motion except at the shoulder-joint. They are completely enveloped in a thick skin; which prevents any trace of these bones from being seen externally.

Fig. 121.—Swimming-paw of Whale.

209. The character of the skin in these animals is very peculiar. In other animals in which there is a tendency to the accumulation of oily matter, it is disposed as a layer of adipose

tissue (ANIM. PHYSIOL., § 44) beneath the skin; but in the Cetacea it is deposited in the substance of the skin itself, which is of enormous thickness, consisting of elastic fibres interlacing in every direction, in the interstices of which the oil is contained. This substance is commonly known as *blubber*. The arrangement which has been described appears to serve two purposes; it serves to keep in the heat of the body, which would otherwise be too rapidly carried off by the conducting power of the water in which it floats; and it enables these animals to sustain the enormous pressure, to which they are subjected, when they sink deep below the surface,—a pressure sometimes amounting to a *ton upon every square inch*. The thickness of this layer of blubber is never less than several inches, and it is sometimes between one and two feet; its weight not unfrequently amounts to thirty tons; but being lighter than water, it buoys up the enormous body which it incloses, instead of weighing it down.—The remarkable conformation of the circulating apparatus, by which the necessity for frequent respiration is dispensed with, has been elsewhere described (ANIM. PHYSIOL., § 265).—The act of respiration is facilitated by the position of the nostrils, which are situated nearly at the highest point of the head; so that the animal can breathe as soon as the head comes to the surface of the water. The Whales have the power of forcing out water through these passages, by means of a peculiar apparatus with which they are provided. This consists of two pouches or reservoirs, situated beneath the nostrils, and communicating with the back of the mouth by the usual nasal passage, which is furnished with a valve. When the animal wishes to eject water contained in its mouth, it moves its tongue and jaws as if about to swallow it; but, by closing the pharynx, it compels the water to ascend through the nasal passage, whose valve it forces open, and to distend the reservoirs. There it may be retained, until the animal desires to *spout*; and this is effected by a forcible compression of the pouches, which compels the water to escape by the nostrils or blow-holes, its return to the mouth being prevented by the valve just mentioned. The aperture of the nostrils is guarded by a conical valve or stopper; composed of numerous

fibres so closely interwoven and compressed, that it is difficult to cut it with a knife; and so perfectly adapted to the opening, that not even the enormous pressure just now stated can disturb or injure it, or force a drop of water between its sides, and the tube which it closes. Of the sense of smell, the Whale can possess but little. The aperture of the ear is closed by a similar valve. It appears that, when under water, the Whale can hear the smallest sounds, such as the slightest splash of an oar; but that to sounds in the air above, even the report of a cannon, it is insensible.

210. The Cetacea are all carnivorous; but the nature of their food varies considerably. In some it consists of Fishes; others seem peculiarly to prefer the Cuttle-fish; others feed upon the smaller species of their own order; whilst the Whale, the largest of all, is supported chiefly by minute Mollusks and Crustacea. The teeth vary extremely in the different genera; and cannot be alone trusted to, as characters for subdividing the order into families. Excluding the MANATIDÆ,—which, though Whale-like animals, belong to the herbivorous series, and differ from the true Cetacea in many important particulars,—we may naturally divide the order into three families.—1. DELPHINIDÆ, or *Dolphin* tribe, characterised by the moderate size of the head; and usually by the presence of teeth in both jaws.—2. CATODONTIDÆ, the *Cachalots* or *Spermaceti-Whales*, characterised by the very large size of the head, which constitutes one-third, or even nearly one-half, of the entire length; and also by the presence of teeth in the lower jaw.—3. BALÆNIDÆ, the *Whalebone-Whales*, also distinguished by the enormous size of the head, but altogether destitute of teeth.

211. The family DELPHINIDÆ includes, with the *Dolphin* and *Porpoise*, many animals which are ordinarly called Whales. A large proportion of these are occasional visitants of our own coasts, especially towards the north of Scotland, and off the Orkney and Shetland islands. The teeth are usually numerous; simple in their structure, and conical in form.—The common *Porpoise* is an active and voracious animal, feeding especially upon fish, and following in the wake of the shoals of Herring and

other species which periodically visit our coasts. It frequents, often in large troops, the bays and inlets of our coasts, and espe-

Fig. 122.—Porpoise.

cially the mouths of rivers; and occasionally advances to a considerable distance up the stream. It is very common in the estuary of the Thames. Its length is from four to eight feet. The *Dolphin* chiefly differs from the Porpoise in having the muzzle prolonged into a kind of slender beak. It is a peculiarly agile animal; and often follows ships in numerous herds, executing the most amusing gambols, apparently for no other purpose than mere pastime. The flesh of the Dolphin and Porpoise was formerly used as food; but it is rank and oily, and is now seldom or never eaten. The length of the common Dolphin is from six to eight or even ten feet.—The *Grampus* is another animal of this family, nearly allied to the Porpoise, and chiefly distinguished from it by its high dorsal fin. It is very powerful and voracious; and preys not only upon Fishes, but upon the smaller Cetacea. The stories of its attacking the Whale, however, are probably without foundation. The Grampus is less disposed to associate with others of its kind, than are most of the Delphinidæ; but it is sometimes seen in shoals of six or eight. The Author has known one to keep company with a ship for several days; swimming round and round it, when it was going through the water at the rate of eight or ten miles an hour, with the greatest ease.—Another allied species is the *Round-headed Porpoise*, or *Caaing Whale*, which is remarkable for its tendency to associate in large numbers, and for its strong instinct of attachment. It not unfrequently appears on the shores of the Orkney, Shetland, and Feroe islands, and also of Iceland, in herds of from two or three hundred to a thousand in number;

the fishermen of the neighbourhood endeavour to close in upon them from without, and drive them towards the beach; and no sooner is one individual driven on shore, than the rest of the herd rush with a blind impetuosity towards the spot, and throw themselves forwards with such violence, that they are stranded on the beach, and become an easy prey to their pursuers. There is reason to believe, that the cries of distress uttered by the first victims attract the others to their rescue; and that their destruction is thus due to their strong attachment to each other. It is thought by others, however, that they are led towards the shore by their tendency to follow their leaders with a blind confidence. The common name of this species, "Caaing," is understood to mean "driving" in Zetland.—The *Beluga*, or *White Whale*, an allied genus, is remarkable for the clear white hue of its skin, which is slightly tinged with yellowish or rose colour. It rarely visits our own coasts; but is often seen in the northern regions, sporting, feeding, and migrating, in herds of moderate numbers. Its teeth are fewer in number than are those of most other Delphinidæ; and of the few which it possesses, the greater number fall out before it attains an advanced age.

212. There are some aberrant genera of this family, in which the number of teeth is small; or in which they are even entirely absent from one of the jaws. This is the case with the *Hyperoodon*, or *Bottle-head Whale*, in which there are only two teeth, and these situated in the lower jaw. It is a large animal, usually more than twenty feet long; it rarely visits our coasts and little is known of it.* A much more remarkable animal is the *Monodon*, or *Narwhal*, commonly known as the *Sea Unicorn*; which derives its name from its obvious peculiarity,—the presence (in the Male) of a single tooth of great length, projecting from the front of the upper jaw. The usual length of this extraordinary appendage is about six feet; but it sometimes reaches nine or even ten feet. It is quite straight, and tapers gradually from its base to its point; but it has a spiral twist from left to right. It would be a strange anomaly if such a weapon were

* A specimen was taken a few years since in the Severn, whose length was twenty-two feet; its skeleton is now in the Museum of the Bristol Institution.

really *single*; but the fact is, that the rudiments of two teeth are always present, and this not in the male only, but in the female. Sometimes the tooth on the right side is developed; sometimes that on the left; the corresponding tooth remaining small, or even permanently concealed. But instances are occasionally met with, in which both teeth have been developed to a considerable extent,—even in the female. The use of the tooth seems to be merely that of an organ of defence; it cannot assist the animal in obtaining its food; for this consists merely of mollusks and other soft animals. Its body much resembles that of the Beluga in form, and agrees with it in being without a dorsal fin. It is an active powerful creature, swimming with almost incredible swiftness; it inhabits the northern seas, rarely coming so far south as even the Orkney Islands. When attacked, it shows great ferocity; and has been known to drive its horn, or rather tusk, deep into the thick oak timbers of a ship. Besides these, may be mentioned the *Inia*; a remarkable fresh-water genus of Delphinidæ, inhabiting the remote tributaries of the Amazons, some thousands of miles from the sea. It has the external form of the Dolphin, with some coarse bristly hairs on the snout; the lips are deeply cleft; and the nostrils are placed far back, above the paddles. A female specimen measured seven feet in length; and the males are stated to be double that size. Two or three other species of Dolphins from the fresh waters of South America have lately been described.

213. Of the family CATODONTIDÆ, only two species are known; the common *Cachalot*, or Spermaceti Whale; and the high-finned Cachalot. The former is the one which is the object of pursuit, on account of the oil and spermaceti which it yields; the latter is comparatively rare. The head of the Spermaceti Whale nearly equals the rest of the body in length, and surpasses it in bulk. This enormous size, however, is not due to the great development of the brain; but to the presence of a very large receptacle for the Spermaceti, which lies in a hollow on the upper part of the cranium. This receptacle consists of a dense bag, divided into compartments; and the substance which it contains is in a semi-fluid state, consisting of Spermaceti united with oil.

The oil is separated by draining and squeezing; and the spermaceti is purified by melting it in water. A similar oleaginous substance exists in cavities placed along the back, and in other parts of the body. The Spermaceti Whale is also furnished with a layer of blubber, which yields a thinner and purer oil than that of the Common Whale; but its amount is less. Another substance of some value is yielded by this animal,—namely, *ambergris*. This is a rather hard brittle matter of a gray colour, having a peculiar odour, for which it is much esteemed by some persons as an agreeable perfume; it is formed by a secretion within the intestines, and seems to be a product of diseased action, occasioned by the accumulation of indigestible substances. The Cachalot sometimes reaches the length of seventy feet. It is a very powerful animal, and swims with considerable rapidity; and from the violence of its fury when attacked, it is one of the most dangerous of the monsters of the deep, with which the daring sailor is called upon to combat. Not only are the strong whaling boats occasionally dashed to pieces by a single blow of the tail, but even a ship of large size has had its bottom stove in by a blow inflicted by the head of an infuriated male Cachalot. The Spermaceti Whale is found in all seas; but is most abundant in those near the southern pole. It associates in small parties, which usually consist of half-grown males, or of females attended by their young, and guarded by one or two very large males. When solitary Cachalots are observed, they invariably prove to be aged males. The food of these gigantic animals consists of fishes, cuttle-fish, &c.

214. The family BALÆNIDÆ, or *Whalebone Whales*, contains two genera, each including but one species; these are the *Balæna*, or *Greenland Whale*, and the *Balænoptera*, or *Rorqual*. The former is the one best known; the latter is distinguished from it by the slenderer form of the head, and by the presence of a dorsal fin. In both there is an absence of teeth (although the rudiments of them may be detected in each jaw), and the palate is furnished with an apparatus for straining out the small mollusks, minute fishes, and medusæ, on which these huge animals are supported. This consists of a series of plates of

baleen, or whalebone, which are suspended from the roof of the mouth; the base of each plate is imbedded in the substance of

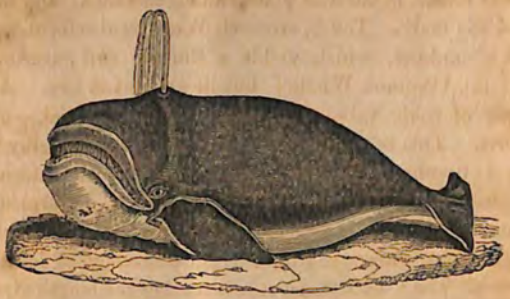

Fig. 123.—Greenland Whale.

the gum, or membrane that covers the palate; whilst its edge forms a sort of loose fringe, composed of matted fibres. The filaments of the fringe fill up the cavity of the mouth, sufficiently to form a most complete sieve. When the immense mouth of the Whale is opened, a great number of the small marine animals with which the Arctic seas are often crowded, are engulphed in its vast cavity; and the water being got rid of by the process of *spouting*, already described, all that floated in it is retained within the mouth upon the fringes of baleen. In this manner the gigantic fabric of this animal derives its nutriment; though its swallow is not large enough to admit even small fish. The Whale usually rises to the surface to breathe, about every seven or eight minutes; but it can remain under water for half an hour, or even longer. When struck with the harpoon, it descends rapidly to a gr

Fig. 124.—Whalebone and Skull of Whale.

depth, — sometimes nearly 1000 fathoms; and it has been known to strike itself so violently against the hard bed of the ocean, as even to fracture its jaws. This Whale usually lives in pairs, but sometimes the abundance of food in a particular spot draws a number together. The female shows the most devoted attachment to her young; always coming to its assistance when it is attacked, even to her own certain destruction. The length of the Greenland Whale is from 60 to 70, or even 80 feet; that of the *Rorqual* (of which a skeleton was exhibited not long since in the principal towns of this country) often exceeds 100 feet. The latter is not often chased; as the quantity of blubber it yields is small, and the whalebone of inferior quality.

Order VII.—RODENTIA.

215. We now proceed to the Herbivorous series of the higher division of the Class Mammalia; and we shall have to notice in it a series of forms very different from those which have hitherto engaged our attention. The order Rodentia, which next presents itself to our consideration, occupies, in many respects, an intermediate place between the purely carnivorous and the purely herbivorous Mammalia, so as to form the connecting link between them. We have seen that in the first (with the exception of the Cetacea, which are *aberrant* forms of the Carnivorous series, and a few other aberrant genera), *three* kinds of teeth are always found; the bones of the fore-arm are separate, so that the hand, or fore-foot, has the power of rotation; and that the fingers are distinct, and terminated by separate nails or claws. In the Ruminant quadrupeds, which may be considered as the *types* of the second group, there is a complete want of canine teeth; the bones of the fore-arm are consolidated together, so that the fore-foot loses all power of rotation; and the bones of the toes are also partly united, and their extremities inclosed in a hoof, which totally destroys the power of prehension, and blunts the sensibility of the organ, so that it becomes merely an instrument of support and motion. Now in the order Rodentia, or *Gnawers*,

we observe an interesting gradation between these two divisions of the class. Although the animals comprising it are chiefly adapted to a vegetable diet, their feet are endowed with a greater variety of function, than are those of the Ruminant quadrupeds. They are still, like those of the Carnivora, *unguiculated*, or furnished with claws; their toes remain separate, as do also, for the most part, the bones of the fore-arm; and in many species the clavicles or collar-bones are present, which serve to keep apart the shoulders, and thus to give to the upper extremities a greater freedom of motion.

216. The chief peculiarity of this order is seen in the remarkable conformation of the teeth. All the animals which it includes may be at once recognised by the presence of two large cutting teeth, which project from the front of each jaw. These teeth are usually regarded as *incisors;* but they have also been considered as *canines*, the direction of which has been changed by the absence of the incisors, as in the Hare, and a few others of the order, small true incisors may be seen behind the two large gnawing teeth. Some approach to this structure may be seen in the Lemur tribe, especially in the *Aye-aye*, which was placed by Cuvier among the Rodentia (§ 164). The conformation of the gnawing teeth is beautifully adapted to the purpose they have to fulfil. In order to make their way through tough vegetable substances, a sharp edge is required for them; and they must at the same time possess great strength and firmness. For this purpose, the tooth is principally composed of very tough *ivory*, with a plate of hard *enamel* in front only (See ANIM. PHYSIOL., § 177-180). By the friction of the teeth against each other, their substance is continually being worn down; but the hard enamel of course wears most slowly, and is always left as a sharp projecting edge. These teeth differ also from any which exist in the Mammalia previously described, in the circumstance that their growth is contin-

FIG. 125.—SKULL OF RODENT ANIMAL.

going on, instead of stopping at an early period of life. Each tooth passes far backwards into the jaw, and is quite hollow at its lower extremity, which is filled with pulp; from the surface of this, new ivory is continually formed, and thus the tooth is constantly being pushed up, at about the same rate as it is worn away at the top, so that its edge is kept up to its proper level. If, however, in consequence of the fracture of the opposite tooth, or from any displacement of the jaw (which sometimes results from accident), the usual wear of the summit of the tooth does not take place, its length continues to increase, often to the great inconvenience of the animal. In fact, cases have been known in which death was the result; the unchecked growth of the tooth having caused its point to advance in a curve upwards and backwards, until it penetrated the skull and entered the brain.—The molar teeth, which are separated from the incisors by a wide interval, are composed of alternate plates of enamel and ivory; the former of which will, from their slower wear, always remain standing up in ridges, so as to give a rasp-like surface to these teeth. The ridges are always transverse, or in a direction from side to side of the head; and as the lower jaw is endowed, by the peculiar form of its joint, with considerable power of moving backwards and forwards, these teeth obviously become very powerful instruments for the reduction of hard vegetable substances. In the frugivorous (fruit-eating) species of the order, however, such as the Squirrel, the surface of the molar teeth is raised into rounded tubercles, as in the frugivorous animals; whilst in those which have any carnivorous tendency, such as the Rat, they are raised into sharp points, so as to bear some resemblance to those of the purely Carnivorous quadrupeds. —The digestive apparatus in this order is evidently adapted, by the length and complexity of the alimentary canal, to the reduction and preparation of vegetable food; and this is the prevailing habit of all the animals which it includes. Their function obviously is, to make the hard portions of plants, which are rejected by other animals, available as nourishment; but there are some which are so omnivorous in their propensities, as to devour with voracity almost anything that falls in their way.

217. The animals composing this order are mostly of small size,—the *Capybara* (§ 234), which is the largest, not equalling a pig in bulk: but they are very numerous, and are widely diffused over the globe. They are amongst the most generally distributed of terrestrial mammals, species being found in all parts of the World, a few even in New Holland, where with the Bats they form the only exceptions to the generally Marsupial character of the Mammals. They are most abundant, and present themselves in the greatest variety, in South America, and that continent is also the habitation of the largest species. The Rodentia exhibit considerable variety of disposition; some being very docile and gentle, whilst others are savage and untameable: but the former is certainly the general character of the group. Some of them are remarkable for the high development of their *instinctive* powers, but none of them exhibit any considerable degree of *sagacity* (ANIM. PHYSIOL., Chap. XIV.): and their brain, in the nearly entire absence of convolutions, and in other characters, more resembles that of Birds than that of the higher Mammalia. It has been justly remarked, that they are more easily *tamed* than *educated*; their intelligence not being sufficient to enable them to learn. These animals usually multiply very fast: they produce large litters several times a year; and the young speedily arrive at maturity, requiring, for the most part, but little care on the part of their parents during the period of infancy. This is one example, therefore, of the general principle, the applications of which have been elsewhere dwelt upon, that, the higher the development which is ultimately to be attained by a Plant or Animal, the longer is the period of preparation for it, and the greater is the assistance which it needs during its early state. With the exception of some remarkable aberrant forms, there is a considerable similarity throughout the whole group. Nearly all of them agree in the large size of the posterior extremities, as compared with the anterior; and this is sometimes almost as considerable as in the Kangaroos. Most of them have the habit of sitting upon their haunches, and of using their anterior members for the prehension of food, &c.; not, however, as in higher animals, by grasping it in ei

hand, but by holding it between the two paws, as seen in Fig. 48.

218. The principles upon which the division of this order into families should be founded, have not yet been satisfactorily established. It is convenient, however, to distribute them in the first instance into two sections; of which the first, possessing clavicles, includes the Squirrels, Mice, and Beavers; whilst to the second, in which the clavicles are nearly or completely absent, belong the Porcupines, Hares, and Guinea-pigs. The three principal families constituting the first section, may be distinguished by the form of the tail, and the number of the molar teeth. In the SCIURIDÆ, or *Squirrel* tribe, the tail is large and bushy; and the molar teeth are four on each side, with a fifth in the upper jaw, which soon drops out. The MURIDÆ, or *Mouse* and *Rat* tribe, have a round scaly tail, and only three molars on each side. The family CASTORIDÆ, which includes none but the *Beavers*, is at once distinguished by the peculiar flattening of the tail, which is covered with scales; there are four molars on each side. Between the two last families may be placed the group of ARVICOLÆ, or *Voles*, which include many species that are commonly termed Rats and Mice; but these are distinguished by a peculiarity in their teeth, that indicates a greater affinity to the Beavers, with which they are classed by some Naturalists.—It is remarkable that the Rodents of this series should be much more extensively diffused over the globe, than those of the families hereafter to be described. There is no part in which some kinds of Mice and Rats are not to be found; and Squirrels are as widely diffused, with the exception of New Holland. The order is most abundant in temperate regions,—the reverse of which is the case, in regard to Mammals of large size.

219. The family SCIURIDÆ, or *Squirrel* tribe, contains a large number of species, many of which bear a strong resemblance to each other. Some of them, like the common Squirrel of this country, (Fig. 48,) have a very extensive range, and are liable to undergo great alterations in colour. The form of this little animal is sufficiently well known, to render a particular description of it unnecessary. Living entirely upon vegetable food,—

especially buds and young shoots in the spring and summer, and nuts, acorns, &c. in the autumn and winter,—it spends nearly its whole time amongst trees, leaping from branch to branch with great agility, and seldom descending to the ground, except for the purpose of passing to another tree. They are usually found in pairs, which pairs are believed to associate for life; and they construct little spherical nests, near the tops of the highest trees, by weaving twigs together, leaving an opening at the top. In such places, they and their young are out of the reach of all quadruped foes; but they occasionally become the prey of ravenous birds, when these roam on the wing over the forests they inhabit. Some species of Squirrel associate in large numbers; and others so far resemble the next family, as to form their nests by burrowing amongst the roots of trees.—As already mentioned, the bushiness of the tail is the peculiar characteristic of the Squirrel tribe; and this is of great assistance to them in leaping; for not only does the tail serve to guide them, but even to give them a degree of support, its hairs spreading out sideways, when the animal is in motion, into a sort of feathery expansion.

Fig. 126.—Flying Squirrel.

In the *Pteromys*, or Flying Squirrel, this sustaining power is much increased, by an extension of the skin of the flank between the fore and hind legs; and this, with the tail, forms a kind of parachute, on which the agile little animals are sustained in their long leaps from bough to bough, the first impulse being given by their powerful hind-legs. But, as elsewhere explained,

(ANIM. PHYSIOL. § 668,) this movement cannot be rightly designated as *flight*, since the animal is not able to propel itself in the air, nor even to sustain itself at the same height.—In some of the Squirrels, the tail is rounder and less bushy than in the common one of this country; these, consequently, have less power of taking sustained leaps through the air; and they live more upon the ground.

220. The *Marmot* and the *Dormouse* seem to occupy an intermediate position between this family and the next. The *Marmot* has been commonly associated with the Rats; but in its dentition it more nearly resembles the Squirrels. The body is

FIG. 127.—ARCTOMYS, OR MARMOT.

heavier, however, than it usually is in that family, and the limbs are shorter; the tail is of moderate length, and hairy. The Marmots construct extensive burrows, with long galleries, preferring the sides of high and cold mountains. They pass the winter in a state of profound torpidity; not even occasionally arousing themselves to take nourishment. They prepare a couch of dry grass, in which they nestle; and they securely close the mouth of the burrow, and prevent the changes in the external temperature from affecting their bodies, by carrying in a ball of hay *backwards*, and drawing it firmly into the orifice. A subdivision of this group, peculiar to North America, is remarkable for its large cheek-pouches, which enable these little animals to carry the stores of grain on which they feed. They are described by Dr. Richardson as living in communities, and as occasionally

gambolling for hours together near the mouths of the burrows; sentinels having been previously appointed, which indicate to them, from some elevated situation, the approach of danger, and which also reconnoitre when they are about to go on their predatory excursions.

221. The *Dormouse*, also, has been commonly associated with the Rats; but in its general habits, the structure of its teeth, and the hairiness of its tail, (which in some species spreads out into a tuft at the end,) it presents a nearer approach to the Squirrels. It has their lively expression and active movements; and, like them, it builds a kind of nest in the foliage, which is usually, however, situated near the ground. A species which inhabits Southern Europe is known to attack small birds; but the usual food of that which inhabits this country, consists of haws, young hazel-nuts, and fallen acorns. Of these it lays up a hoard for the winter; which period is passed by it in a state of almost constant torpidity, though it occasionally awakes to take food. The peculiar nature of this state of *hybernation*,—which is better displayed in the Dormouse, than in any other warm-blooded animal of our own country, except the Bats,—has been elsewhere explained (ANIM. PHYSIOL. § 309). The true Squirrels also pass a large part of the winter in sleep; but they frequently awake to take food, of which they lay up a plentiful store during the autumn.

222. Another intermediate link between the Squirrels and Rats, but agreeing with the latter rather than with the former, is the *Jerboa*, which is distinguished by the enormous development of its hind-legs and tail; causing it to bear considerable resemblance in form to the Kangaroo; and enabling it, like that animal, to take prodigious leaps. It resembles the Squirrels in possessing a hairy and tufted tail, and also in the disproportion of its fore and hind-legs; but in the conformation of its teeth, it is more allied to the Rats. It is a native of Egypt, Syria, &c.; and was known to the ancients under the name of *Dipus* (two-footed), which it still bears as its scientific appellation.

223. The family MURIDÆ, consisting of *Mice*, *Rats*, and other animals allied to them, contains the smallest, and at the same

time the most numerous, of the Mammalia. As already mentioned, the animals composing it are distinguished by their long round scaly tails, and by the presence of only three molars in each jaw; these are originally furnished with rounded tubercles, but wear down into roughened disks. No undomesticated animals are better known than mice and rats. Of the common Mouse, Cuvier thus concisely speaks,—"known in all times and in all places." Of the Rats, two species are known in this country, in which they have become completely naturalized, though there is reason to believe that neither is an original inhabitant of it. The *Black* Rat is commonly termed the *old English Rat*, having been known before the introduction of the other; but it appears not to have been known in England before the middle of the 16th century, when it was introduced from France. This is now becoming rather a rare animal in this country; having been nearly extirpated by the other species, for which, on account of its inferior size and strength, it is an unequal match. It is now chiefly found in the old houses of large cities, such as London and Edinburgh; and especially in the cellars and stables of the former. The *Brown* species is commonly known as the Norway rat; but to this title it has no claim whatever, since probably not a single individual had existed in that country at the time it received the appellation. It is believed to have originally come from Persia, where it lives in immense burrows; and is said to have first arrived on the European side of the Volga after an earthquake in 1727. From that time it gradually spread through Europe, and was introduced into England about the middle of the last century. Its astonishing fecundity, its omnivorous habits, the secrecy of its retreats, and the ingenious devices to which it has recourse, either to retain its existing place of abode, or to migrate to a more favourable situation, all conduce to keep up its overwhelming numbers. By its power of adapting itself to a great variety of circumstances, in regard to food, temperature, and habits, it has been enabled to spread itself, by means of British vessels, to America, New Holland, and almost every other part of the globe; and has already become a source of inconvenience in many of these localities.

224. Both kinds of Rat are extremely voracious, and occasionally show great ferocity when attacked. They have been not unfrequently known to attack children and infirm persons when asleep; and will even "show fight" against more powerful opponents. Of all the Rodentia, the Brown Rat seems most capable of subsisting upon an exclusively animal diet; of this, the following is a remarkable example. At Montfauçon, in the neighbourhood of Paris, is a very large establishment for the slaughtering of horses; and the number of rats which exist in the neighbourhood, and which gain their subsistence from this source alone, is so enormous, that the carcasses of the horses killed in the course of a day, (sometimes amounting to thirty-five in number,) are found the next morning picked bare to the bone. A proposition was made, some time since, for the removal of the establishment to a greater distance; and one of the chief obstacles urged against it was the fear entertained of the dangerous consequences that might result to the neighbourhood, from suddenly depriving these voracious animals of their proper sustenance. The following experiment was made by the head of the establishment, with the view of gaining an idea of the number of Rats in its vicinity. A part of it consists of a yard inclosed by solid walls, at the foot of which are several holes made for the ingress and egress of the Rats. Into this inclosure he put the carcasses of two or three Horses; and, towards the middle of the night,—having first cautiously, and with as little noise as possible, stopped up all the holes,—he got together several of his workmen, each having a torch in one hand, and a stick in the other. Having entered the yard, and closed the door behind them, they commenced a general massacre. It was not necessary to take any aim; for no matter how the blow was directed, it was sure to immolate a Rat; and those which endeavoured to escape, by climbing up the walls, were quickly knocked down. By a recurrence of this experiment, at intervals of a few days, 16,050 Rats were killed in the space of a month. After one night's massacre, the dead amounted to 2,650; and the result of four hunts was 9,101. Even this can give but an imperfect idea of the number of these vermin;

for the inclosure in which they were thus killed, contains not above the twentieth part of the space over which the dead bodies of Horses are spread, and which, it is but fair to suppose, must equally attract the Rats upon all points. These animals have made burrows for themselves, like Rabbits, in the adjoining fields, and hollowed out into catacombs all the surrounding eminences;—and this to such an extent, that it is not unusual to see the latter crumble away at the base, leaving these subterranean works exposed. So great is the number of these animals, that they have not all been able to lodge themselves in the immediate vicinity of the slaughter-houses; for paths may be distinctly traced, leading across the fields, from the inclosures in which the Horses are killed, to a burrow about five hundred paces distant.

225. The voracity and ferocity of Rats cause them not even to spare their own kind. If several be inclosed together in a box, they fight furiously; and the weaker is not only killed but devoured by the stronger. (The same has been observed even of the common Mouse.) Their burrowing propensities have often been productive of great injury; for they have not unfrequently excavated the foundations of a dwelling to a dangerous extent; and there are many instances of their fatally undermining the most solid mason-work, or burrowing through dams, which had for ages served to confine the waters of rivers and canals. The Brown Rat swims with great ease. Mr. T. Bell * mentions that the gardens of the Zoological Society of London, in the Regent's Park, are greatly infested by them; but as they are too cunning to risk the danger of being caught during the day-time, or alarmed, perhaps, at the concourse of persons by whom the gardens are frequented, they are often seen towards evening crossing the canal in a body from the opposite shore, in order to land in the gardens, and enjoy their night's depredations, returning in the morning in the same manner to their daily retreat. This animal is probably one of the most *sagacious* of the Rodentia; for the instances in which it has been observed to show an adaptation of means to ends, to which it can scarcely have been led by its natural *instincts*, and

* History of British Quadrupeds, p. 319.

which must be attributed to *intelligence*, are very numerous. It has been mentioned to the Author by a trustworthy eye-witness, that she once saw a number of Rats conveying eggs safely down a flight of stairs, from a store-room above to their haunts below. Each egg, held between the fore-paws of a Rat, was delivered by it, over the edge of the step, to another reared upon its haunches on the step below; and in this manner the eggs were safely transferred from the top to the bottom. In another instance, the following expedient was adopted by a number of Rats, to get at some treacle contained in a jar, of which the neck was too narrow to permit them to obtain direct access to it. One Rat after another inserted his tail into the orifice, and dipped it in the treacle; then, withdrawing it, he allowed his companions to lick off the fluid; and in his turn received a share of that abstracted by his companions in like manner.*

226. To the group of true *Mice* belongs the beautiful little *Harvest Mouse*,—the smallest of British quadrupeds, and one of the smallest of the whole class,—which constructs a curious globular nest for its young, by weaving together the blades of wheat: and also the *Long-tailed Field Mouse*, which burrows beneath the ground, or lives in natural excavations, which it enlarges to suit its purpose. Both these are very beautiful little animals, and highly interesting to the naturalist, though very injurious to the Agriculturist.

Fig. 128.—Nest of Harvest Mouse.

227. Connecting the Rats with the Marmots is a curious animal of larger size, the *Capromys* or Hog-rat, which inhabits Cuba, where it is called *Hutia* or *Utia*. This is a climbing, not a burrowing species; it lives in large numbers in the woods of Cuba, and feeds entirely on vegetable matter,—reaching the leaves of those short plants which it does not require to climb, by making use of the tail as a third foot, somewhat in the manner of a Kangaroo. In its mode of walking on the

* The editor has also heard that in Gibraltar the Rats were found to plunder the flasks of olive oil by the same ingenious expedient.

ground, in the rough and bristly hair on the upper part of its body, and in the low grunt it makes when pleased, it bears a slight resemblance to a Hog; whence the first part of its common name has originated. This species is easily domesticated, and is very docile in captivity.—The *Hamster*, which has been elsewhere noticed on account of its remarkable instincts (ANIM. PHYSIOL., § 699), is another species of the Rat kind; and is distinguished by its two enormous cheek-pouches, in which it carries grain to be stored up in its extensive hoards. Its tail is short and somewhat hairy. It inhabits the sandy districts of the north of Europe and Asia, from Germany to Siberia; and is very injurious to the Agriculturist, on account of the quantity of grain which it devours. It does not restrict itself to vegetable food, however; but attacks and devours other small quadrupeds and birds.

FIG. 129.—HAMSTER.

227. There is another very interesting species, which seems intermediate between this group and the next;—the *Spalax* or Mole Rat of Southern Russia in Europe. This animal is nearly

FIG. 130.—SPALAX OR MOLE-RAT.

allied to the Rats in general conformation; but presents some remarkable points of resemblance to the Mole, both in structure

and habits. It lives underground, like the Mole, and throws up the earth in the same manner, although provided with very inferior instruments for the purpose; but instead of feeding on worms and grubs, it subsists entirely on roots. It works stoutly and rapidly; and on the approach of an enemy instantly digs a perpendicular burrow. The most curious point in its structure, is that in which it resembles the Mole,—the deficiency of eyes fitted for vision. These organs are in an undeveloped or rudimentary state, being small black globules no larger than poppy-seeds; they are hid beneath the skin, which passes over them without opening or even becoming thinner, and which is as much covered with hair at that part as at any other. The Russian species is somewhat larger than the common Rat; but there is another, in the islands of the Straits of Sunda, which is as large as a Rabbit.

228. The tribe of ARVICOLÆ or *Voles* includes many species which are commonly termed Rats and Mice, but which are distinguished by a peculiarity in the teeth, that indicates an affinity with the Beaver. To this group belongs the *Short-tailed Field-mouse*, which is remarkable for its extraordinary voracity, and for the rapidity of its multiplication. It burrows through the ground, destroying the roots of plants and trees which come in its way; and it also devours their bark. In this manner it has done great injury to young plantations, especially in the Forest of Dean, and in the New Forest, Hampshire; and in the years 1813 and 1814 its ravages were so great, as to create considerable alarm, lest the whole of the young trees in these extensive woods should be destroyed by them. Various plans were suggested for their destruction; but none proved so successful as the digging of holes about 18 or 20

FIG. 131.—SHORT-TAILED FIELD MOUSE.

inches in depth, and much wider at the bottom than at the top, so that the Mice which should fall in might not easily get out again. It was calculated that, in the Forest of Dean, not fewer than 100,000 Mice were taken by means of these holes, in the course of a few months; as many as 30,000 having been counted out from them; and a much larger number having been probably destroyed by Stoats, Weasels, Kites, Hawks, Owls, and other predaceous quadrupeds and birds, which resorted to these holes to secure an easy and abundant prey. An equal number was destroyed in the New Forest; and the evil has not since returned, to anything like the same extent. The Field Voles, like Rats, will kill and eat their own kind, when pressed by famine, or kept in confinement. The so-called *Water Rat* is also in reality a Vole. It burrows in the banks of streams, forming its retreat at some distance from the water; and in this it lays up a store of vegetable substances, on which alone it feeds. It dives and swims with great facility, instantly seeking the water when alarmed, and plunging at once to the bottom; it is obliged, however, to return to the surface for respiration, at intervals of about a minute. The *Lemmings* of Siberia and Northern Russia also belong to this group; they burrow and ordinarily feed on grass, rein-deer lichen, &c.; but they sometimes multiply to such a degree, as to be forced to migrate, in order to obtain food. These migrations are performed by immense numbers at once; they move straight onwards, destroying everything in their way, until they arrive at the ocean, where most of them are drowned. —A curious animal, which closely connects this group with the Beaver, is that known in Canada as the *Muskquash*, or Musk-Rat, on account of the musky odour it produces. It is about the size of a Rabbit; its fur is of a reddish-gray; its feet are partly webbed, and its tail somewhat flattened. In summer it burrows in the banks of streams and swamps; and in winter it builds mud huts on their margins, and sometimes even on the ice itself. The entrance to these huts is under water, for the purpose of procuring food, which consists entirely of aquatic vegetables: and by very severe frost, these animals are consequently destroyed, through want of food and air. It is said that, when the

ice closes their holes, they attack and devour one another. Their fur, like that of the Beaver, is peculiarly adapted for *felting;* and from four to five hundred thousand skins are annually imported into England, for the manufacture of hats.

229. The preceding group is occasionally associated, with the Beaver, in the family CASTORIDÆ; of which the *Beaver* is to be

FIG. 132.—BEAVER.

regarded as the type. This animal is distinguished from all other Rodents, by its horizontally-flattened tail, which is of a nearly oval form, and covered with scales; the hind feet are webbed, and, together with the tail, serve to propel it through the water with considerable facility. The incisor teeth are very large and peculiarly hard; and they were employed by the North American Indians, as instruments to cut bone and to fashion their horn-tipped spears, till they were superseded by the introduction of iron tools from Europe. The molar teeth are four, above and below, on each side; they are furnished with layers of *cortical substance*, as well as with ivory and enamel (ANIM. PHYSIOL., § 178); their crowns are flattened; and they present very much the aspect of a riband folded upon itself, as

FIG. 133.—MOLAR TEETH OF THE BEAVER.

shown in Fig. 133. The Beavers are best known as inhabitants of Canada, and of the northern parts of the United States; where alone their remarkable building propensity (which has been elsewhere described, ANIM. PHYSIOL., § 706), is fully manifested. But they are at present found also on the banks of the Rhone, Danube, Weser, and other continental rivers; and there is sufficient historical evidence, that they were formerly inhabitants of Britain. As these Beavers do not build, however, but burrow under ground, it has been supposed that they are not of the same species with the American Beaver; but a colony has been recently discovered in a lonely spot, near the source of the river Elbe, in which regular habitations have been constructed; and it is known that the American Beavers take to burrowing instead of building, when molested by Man.—The Beaver is pursued both for its fur, and for the sake of a peculiar odoriferous secretion, termed Castor, which was formerly much used in medicine, but is now chiefly employed by perfumers. The fur was formerly a most important article of commerce. In the year 1788, upwards of 170,000 skins were exported from Canada; and in 1808, as many as 126,927 were sent from Quebec alone to this country, the value of which was estimated at nearly 120,000*l*. Of late years, however, the exportation has greatly diminished; although the country now occupied by the hunters is of far greater extent than formerly; the animals have been exterminated from many extensive tracts, which they formerly inhabited. In the year 1827, the importation into London was little beyond 50,000 skins. This diminution has caused greater care to be taken than formerly, to prevent the destruction of the race; but it may be doubted whether these animals will ever become so plentiful as they once were.

230. The deficiency in Beaver skins is partly supplied, as already mentioned, by those of the Muskquash; and partly by those of a South American Rodent, the *Myopotamus* or *Coypu*, which connects this family with the Cavidæ. This animal resembles the Beaver in many respects, but is of smaller size. Its hind-feet are webbed; but its tail is round, instead of being flattened; and its scaly covering is partly concealed by scattered

hairs. It swims with great ease, and burrows in the neighbourhood of water. It is easily domesticated; and its manners in captivity are very mild. As many as 600,000 or 800,000 skins of this species are annually imported into Britain from South America, chiefly from the Rio de la Plata, under the name of Neutria skins.

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231. The second section of the Rodentia, in which the clavicles are either absent or are imperfectly developed, altogether occupies a lower place in the scale; the animals composing it being for the most part less highly organised, not capable of executing so great a variety of actions, and less remarkable for their instinctive propensities. It is observable that, with the exception of the Porcupines and Hares, which are spread over nearly the whole of the globe, almost all the very numerous genera of which this section consists, are restricted to South America and the West Indian Islands. The principal families comprehended in it, are the HYSTRICIDÆ or *Porcupine* tribe, the CAVIDÆ or *Guinea Pig* tribe, the CHINCHILLIDÆ or *Chinchilla* tribe, and the LEPORIDÆ or *Hare* tribe. These are separated from each other chiefly by characters supplied by the teeth. In the first and last only of these families, the molar teeth are possessed of growing roots; in the others, they are destitute of them. The last is distinguished (as already remarked, § 216), by the presence of small incisors behind the great cutting-teeth; and the Chinchillidæ differ from the Cavidæ, in possessing perfect clavicles.

232. The animals properly composing the family HYSTRICIDÆ, are well known under the name of *Porcupines*, which is derived from the French *porc-epin*, signifying a spiny hog,—a designation conferred upon them on account of their heavy pig-like aspect and grunting voice, and the curious spiny covering which their bodies possess (Fig. 47). These spines, as already explained (§ 76), are nothing else than enormously developed hairs. The best known species of Porcupine is the one which inhabits the South of Italy, Sicily, Spain, and Barbary; it is

between two and three feet in length, and is nearly the largest of the Rodentia. The spines, especially those covering the upper part of its body, are large and long; some of them measuring more than a foot from end to end, and having annular marks of black and white alternating. Its head and neck have a crest of long bristles; and its short tail is furnished with quills of a very singular structure, being open thin-sided tubes, about two inches long, and supported upon slender flexible stalks, which make a considerable sound when they are caused to strike against each other by the shaking of this appendage. When the Porcupine is irritated, it erects its spines in the manner of the Hedgehog, and these spines are often easily detached; but it is quite a mistake to suppose that it can lance them at its enemies. It is a nocturnal and solitary animal, remaining concealed during the day at the bottom of its burrow, and becoming torpid during the winter.—Several other species, most of them possessing shorter spines and a longer tail, are found in different parts of the world; and there are some, the *Coendous*, inhabiting Brazil, which have long prehensile tails, like those of the Sapajous, and the spines hidden, during part of the year, by long grayish-brown fur. This animal lives among trees, instead of burrowing.

233. The family CAVIDÆ, or *Guinea-Pig* tribe, contains the

FIG. 134.—COBAYA OR GUINEA-PIG.

largest species of this order; though even these would be considered small, when compared with other quadrupeds. They are

naturally restricted to tropical America, where they seem to replace the hares and rabbits of other countries; but one species, the common *Guinea-Pig*, has been so long domesticated in this and other European countries, as now to have become quite naturalised in the Old World. Whence the name was derived, which this species bears, there does not seem now a possibility of ascertaining; for it seems to have been introduced into Europe at a very early period after the discovery of South America. This animal possesses a very low degree of intelligence; it lives in societies, inhabiting dry lands covered with low brushwood; and remains concealed during the day, coming forth on the approach of evening to seek its food. It possesses neither cunning to avoid danger, strength to resist, nor swiftness to escape from it; and nothing could save the race from extermination, except its extraordinary rapidity of multiplication. In this respect this species equals, or perhaps surpasses, any other mammiferous animal. The ordinary litter consists of six or eight, sometimes as many as twelve; and young are produced several times in the year. These young come into the world in a state which at once renders them nearly independent of their parents: and although they do not attain their full growth until they are eight or nine months old, they themselves begin to breed at the age of six or eight weeks. There is little besides this readiness of multiplication, and a certain degree of prettiness in their external appearance, which can render the keeping of these animals a matter of either pleasure or profit. "Devoid of sense or docility, though incessantly restless, tame from stupidity, and harmless from impotence, they perhaps possess as few claims upon our interest and affection, as any animal of equally innoxious habits."*

234. Nearly allied to the Guinea-Pig is the *Hydrochœrus* or *Capybara*, which is the size of a small pig, and is the largest known animal of the order. It has a thick muzzle, short legs, coarse yellowish-brown hair, and no tail. Its feet are webbed, showing its aquatic habits; and it is said to exist, in considerable numbers, near all the large rivers of the tropical portion of

* Bell's "British Quadrupeds," p. 355.

South America, readily taking to the water, and swimming and diving with facility. It runs badly, however, upon land, owing

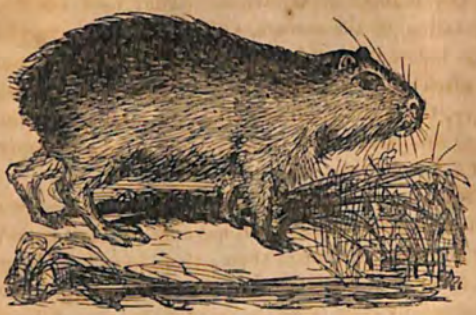


FIG. 135.—CAPYBARA.

to the shortness of its legs. In its disposition it strongly resembles the Cavy; and like it, is capable of being readily domesticated. A friend of the Author's had one alive in his house for some years; and it gave very little trouble, though commonly allowed to go at large.—The *Agouti* is another of the Cavidæ; resembling the Porcupines, however, in possessing roots to its molar teeth; and resembling the Hares, also, in the length of its hind legs, by which it runs or rather leaps with considerable swiftness. When first taken possession of by Europeans, the West India Islands and all the more fertile parts of South America were literally overrun with the various species of this animal; they are still very numerous in most places which are not settled and cultivated; and even in some which are under cultivation, their numbers are so great, as to give no little annoyance. They live for the most part upon the surface of the ground, not climbing,

FIG. 136.—COMMON AGOUTI.

nor digging to any depth; and they commonly sit upon their haunches, when at rest, holding their food between their fore-paws, in the manner of Squirrels. They feed both upon the green vegetation of the surface, and upon the roots which they find a little below it; and by destroying those of the sugar-cane, they are often of great injury to the planters. It is said that, when angry, the Agouti stamps with the fore-feet, grunts like a young pig, and erects the bristly hair of the crupper in the manner of a Porcupine.

235. The family CHINCHILLIDÆ consists of a number of small South American Rodents, which have been until recently only known by the skins of some of them; these have been long highly valued on account of their fur, and have been largely imported. This is especially the case in regard to the *Chinchilla*, a

FIG. 137.—CHINCHILLA.

native of the valleys in the high mountain districts, where the cold is often very severe; its fur is of a dense woolly character, which, together with its fineness of texture, causes it to be highly valued. Its colour is clear gray above, varying however in depth, and passing into white on the under parts. The ancient Peruvians are said to have made of this wool coverlets for beds, and valuable stuffs; but there is reason to believe that, on account of the present extensive destruction of the species, it is becoming more and more scarce. Of its habits in a state of nature, little is known, save that it associates in numbers, and excavates burrows in which it resides, feeding chiefly upon roots,

especially those of a bulbous kind. In captivity, its manners strongly resemble those of the Cavy and Rabbit. The *Viscacha* of the Pampas is another animal of this family, allied to the Chinchilla, but larger, being when full grown of the size of the common Badger. It burrows so extensively in the plains between Buenos Ayres and San Luis, as to make it dangerous to travel over them, especially at night; their holes being so large and deep, that a horse is almost sure to fall, if he steps into one of them. The animal is, for the most part, nocturnal in its habits, being seldom seen until the evening, when it comes forth to feed and to sport near its holes. It is remarkable that the burrows of the Viscacha are also inhabited by vast numbers of small Owls; which are said to sit, during the day, gazing at the passing travellers, and making a very ludicrous appearance.

236. The LEPORIDÆ or *Hare* tribe constitutes the last family of the Rodentia; distinguished, as already mentioned, by the presence of two small incisors behind the cutting teeth of the upper jaw. Few undomesticated animals are better known than the common Hare of this country; which is spread, also, over the greater portion of Europe. Its timidity and defencelessness are beautifully compensated by its watchfulness, the acuteness of its senses, and its swiftness of foot. Its eyes are so situated, that the animal can see nearly all around it; and its large ears can be raised and directed towards any point from which the faintest sound issues. Its brown fur, also, aids to conceal it, by its resemblance to the russet herbage, in the midst of which the Hare's *form* (as the slight hollow made by it is termed) is usually situated. The Hare is an exclusively vegetable-feeder, devouring various kinds of herbage and the bark of young trees; it is nocturnal in its habits, remaining on its form during the day. In its stomach there is a partial division, which gives it a degree of resemblance to that of the Ruminant Quadrupeds; and in the Levitical directions respecting clean and unclean animals, it is enumerated as one of those that chew the cud. It swims well, and takes fearlessly to the water, whether to escape from pursuit, or to seek for food. Besides the common Hare, the Alpine or varying Hare (so named from its usual residence,

and from the changes of colour which it undergoes), inhabits the northern parts of Scotland, the mountainous parts of Ireland, and has been occasionally seen in the mountains of Cumberland. It is intermediate in size between the Rabbit and the common Hare; and tenants the sides and summits of mountains, hiding in the clefts of rocks, or among rocky fragments. Its ordinary food is similar to that of the other species; but during the winter it feeds on lichens and on the seeds of pines. During the summer its colour is a light grey, except on the lips and at the tips of the ears, which are black; but at the approach of winter, it gradually becomes completely white, with the exception of these parts, which remain black. At the return of spring, the white fur is thrown off, and a new gray coat is obtained, which in its turn undergoes the autumnal change. That this change is solely due to the effect of cold upon the hair, is evident from this fact,—that a Lemming (which undergoes a similar change), caught in the summer, during one of the Arctic voyages, and kept in the cabin of the ship, at a warm temperature, retained its summer coat far beyond the usual time; but when taken on deck, on the 1st of February, and exposed to the intense cold of 30° below Zero, the colour of its fur began to change in a few hours, and was completely turned in the course of a week. The purpose of this curious phenomenon is evidently to afford concealment to the animals which undergo it; by the resemblance between the hue of their fur, and that of the surrounding snow.—The common Hare of Ireland has been lately shown to be a species different from that of England; and it is curious that, besides some constant differences in its form, its fur is valueless as an article of commerce; being destitute of the long fine dark hairs, which constitute the beauty of that of the common species.

237. The structure of the *Rabbit* closely resembles that of the Hare; the smaller size of the former constituting its chief variation; but in its habits, as is well known, it is extremely different,—living in societies, instead of alone; and burrowing extensively beneath the soil, instead of squatting upon it. There is reason to believe that the Rabbit was not originally a native of our island; but the

date of its introduction is unknown.—The *Lagomys* or *Pica* of Siberia, an animal nearly allied to the Hare, is of much interest, on account of its peculiar instincts. It is about the size of a Guinea-pig, and lives on the sides of mountains, concealed in hollows in the rocks, or inhabiting burrows which it has itself excavated. In the autumn it selects and dries herbage for its winter provision; and of this it makes regular stacks, which are sometimes four or five feet in height, by eight in breadth. A subterranean gallery leads from the burrow to the stack; so that neither frost nor snow can intercept the communication with it. The herbage is most carefully selected, and consists chiefly of the choicest grass and the sweetest herbs, all cut when most vigorous, and dried so slowly as to form a green and succulent fodder; and the collections of it furnish a valuable supply of food for the horses of the Sable-Hunters. The Picas are also remarkable for their voice; the tone of which so much resembles that of a quail, as to be often mistaken for it, even by the inhabitants of their native districts. Their peculiar loud and sonorous note or *call* is heard only in the morning and evening (except in dark and cloudy weather), and is repeated by each animal, both male and female, at regular intervals.

238. The Fossil animals belonging to this order are mostly found in very recent strata, and generally bear a very close resemblance to those which still exist. Some of them, however, were of much larger size; especially those inhabiting South America. Thus the remains of a species of *Capybara* have been found there, which must have been nearly five feet in length; so as to stand midway between the existing species and the South American Tapir. Remains of an *Agouti*, also, have been discovered, of such a size that the long bones of its hind legs were nearly as large as those of a Roebuck. And of the *Coendou* (or prehensile-tailed Porcupine), a species must have formerly existed, very little inferior to the wild Hog in bulk. Vast numbers of remains of various Rodents allied to the existing species, are found in a fossil state in the caves of that country; and great heaps of bones of the smaller animals of this group at present existing there, are met with in the soil of other caves, in such a

state as to lead to the belief, that they were brought together by Owls. Remains of Mice and Water-Rats have been found in the Kirkdale Cave in Yorkshire.

Order VIII.—EDENTATA.

259. This order contains a number of animals, recent and fossil, which differ from each other most widely in habits, and in those points of their structure which especially adapt them to those habits; and which yet agree in so many essential characters, and are connected together by so many intermediate links, as evidently to require being associated in the same group. The leaf-eating, tree-inhabiting *Sloths*, at present existing in South America,—the gigantic *Mylodon* and *Megatherium*, which formerly inhabited that Continent, and gained their subsistence, not by climbing the trees that afforded it, but by uprooting them with their immense digging feet,—the armour-clothed, insectivorous *Armadillos*, also inhabiting South America,—the hairy, toothless *Ant-Eaters* of the same Continent,—and the scaly *Pangolins* of Southern Africa,—might almost be regarded as types of distinct groups, so widely do they differ from each other in external form and covering. The name given to the order is very liable to mislead; for it might be inferred from it, that the animals composing the group are altogether *toothless*, which is the case in regard to a small section of it only. They all agree, however, in the absence of teeth in the front of the jaws; and the molar teeth, in those which possess them, are comparatively imperfect in their structure, being destitute of enamel and of distinct roots. The Edentata constitute the last group of *Unguiculated* animals; and in the diminution of the number of toes which some of them present, as well as in the complete enclosure of these in a large hoof-like nail, there is an obvious tendency towards the *ungulated* structure, which is fully developed in the succeeding orders.—The existing species of this order may be subdivided into two principal groups, according to the nature of the food on which they respectively subsist;—the first,

to which the name of TARDIGRADA has been given, on account of the slowness of the movements of the animals composing it, consists of the Leaf-eaters;—and the second, which includes the Insect and Flesh-eaters, has received the name of EFFODIENTIA, on account of the digging habits which prevail in it. These names are not, however, by any means universally applicable; for there are digging animals in the first group; and slow-paced ones in the second.

240. The family TARDIGRADA, contains but a single genus of animals now existing, the *Bradypus* or *Sloth*; an animal on which Naturalists have most liberally bestowed their pity. Not only did Buffon fall into the error of supposing it to be an imperfectly-constructed being, whose existence must be a burthen to it; but even Cuvier, whose views were in general much more sagacious, fell into the same mistake. In the construction of the Sloth, he remarks, "Nature seems to have amused herself in producing something imperfect and grotesque;" and he afterwards goes on to speak of their "disproportioned structure," and the "inconveniency of their organisation." The fact is, as Dr. Buckland has well shown,* that the organisation and habits of the Sloth are as completely adapted to each other, as are those of any other animal; and that our different notion respecting it is founded, on our usually seeing it only in an unnatural condition, for which it is not fitted. For the Sloth is formed to be produced, to live, and to die, not on the ground, but in trees; and not on the branches, like the Squirrel or Monkey, but under them; and when this is once fully understood, the complete adaptation of its whole structure to its mode of life becomes apparent.

241. The first peculiarity in the construction of the *Sloth*, which especially strikes the observer, when the animal is placed upon the ground, is the length of the fore-legs, which are twice as long as the hinder pair; and the very oblique connection of the hind-legs with the body, arising from the great breadth of the pelvis. The structure of the wrist and ankle-joints is such, that the palm or sole, instead of being directed towards the

* Linnæan Transactions, 1835.

surface of the ground, is turned towards the body ; so that the animal is obliged to rest upon the side of the hind-foot, and upon the elbow (not upon the extremity) of the fore-limb ; and it can only advance itself, by a most awkward shuffling movement; or by laying hold, with its long crooked claws, of some fixed object, towards which it draws itself. But these peculiarities ought no more to excite our pity and compassion, than the circumstance of Fishes being deprived of legs, and unable to move upon dry ground; for when the Sloth is placed in its natural condition, they show themselves to be most perfectly adapted to its peculiar mode of existence, for which no other animal is equally fitted. When placed in a tree, the Sloth is no longer the slow-moving, piteous-looking, animal which it is commonly reputed ; for it climbs the trunk, and passes from branch to branch, with considerable rapidity, having been known to ascend, in a minute, from the bottom to the top of a lofty tree. The only three species of Sloth, at present known to exist,—the *Ais*, or three-toed Sloths, (of which there are two species, slightly differing from each other), and the *Unau*, or two-toed Sloth,—are inhabitants of the dense forests of the tropical portion of South America, the branches of whose trees are so intertangled with one another, that hundreds of miles may be traversed by passing from one tree to another. Clinging by the hinder claws, the posterior limbs securely embracing the bough, and generally holding by one of their fore-limbs also, they employ the other to hook towards them the foliage on which they browze. Their long arms, with the firm claws by which they are terminated, enable them to pass from branch to branch, even when these are at some distance from each other; and when they live in the more open parts of the forest,

Fig 133.—Ai, or Common Sloth.

where the trees are less contiguous, they take advantage of windy weather, which blows the boughs together, to effect their passage,

Fig. 139.—Unau, or two-Toed Sloth.

—seldom coming to the ground, and completely stripping the tree of its leaves and young shoots, rather than do so. From the peculiar construction of the Sloth, and the remarkable power of resisting *tension*, or strain, which its limbs seem to possess, it appears to feel no more fatigue from remaining suspended beneath a branch for a long time together, than we do from sitting or standing erect,—a position which the Sloth could not maintain for an instant without support. The position which the Sloth assumes during sleep, is no less peculiar than that of its period of activity. It takes its place at the fork of a tree, the arms embracing the trunk, the back resting upon the angle of the branch, and the head reclining on the chest. The animal is thus rolled up almost in the form of a ball; the entire vertebral column, including the neck, assumes a nearly circular curve; and not only is the weight of the whole body maintained in an attitude of ease and safety, but the head is supported between the arms and chest, and the face

lies buried in the long wool which covers those parts, and is thus protected during sleep from the myriads of insects which would otherwise attack it.

242. Although the Sloths might appear to be totally unprovided with the means of defence, and liable to fall an easy prey to their enemies, yet this is really very far from being the case; since their structure is no less adapted for their defence from attacks, than it is for their peculiar dwelling-place and supply of food. In the first place, their long shaggy hair defends them from the insects, which in that climate are so troublesome; its texture is very peculiar, more resembling dry hay, or grass shrivelled and withered by the sun, than the hair of ordinary quadrupeds; and its appearance so much resembles that of the bark and moss of the branches on which the Sloth lives, as to prevent the animal from being easily detected, except when it moves. Its usual position places it above the reach of ordinary carnivorous quadrupeds; but its powerful claws, and the peculiarly *enduring* strength of its long arms, make them very efficient weapons of defence. When attacked on the ground, the Sloth throws himself on his back, fixes his claws on his adversary, and grasps him with enormous power; in this manner he has been known to strangle a dog, holding him all the while at arm's length; and in the same mode he grapples with snakes of large size, which, in his natural residence, are probably his chief enemies.

243. The teeth of the Sloths are not fitted to grind down their food, on account of the absence of the ridges of hard enamel which we find in the molar teeth of other herbivorous quadrupeds; but they are adapted merely to bruise it, or break down the tender structure of the buds and leaves. This deficiency is compensated by the complex structure of the stomach, which somewhat resembles that of the Ruminants (§ 98). In the Two-toed Sloth, the stomach is almost completely divided into two cavities, of which the first is again partially subdivided into three others; four chambers are thus formed, which are obviously analogous to the four stomachs of the Ruminantia; but there is no reason to think that anything like actual rumination takes place.

244. We next proceed to a family entirely consisting of huge fossil animals, which have entirely passed from the surface of the

earth, and which have been named GRAVIGRADA from their massive character. Of one of these, the *Mylodon* (of which there is a magnificent skeleton in the Museum of the Royal College of Surgeons, London), an elaborate account has recently been published by Professor Owen; in which the other animals of the same group are also noticed. All of them appear, from the structure of their teeth, to have been adapted to the same kind of food with the comparatively pigmy Sloths of the present day; but instead of possessing limbs adapted for climbing trees, which could not have borne their enormous weight, their feet were constructed for digging; and the evidence adduced by Professor Owen from the structure of their skeletons, together with the beautiful chain of reasoning which he connects with this, leave no room for doubt, that they obtained their food by digging around the bases of the trees, and uprooting their trunks. "Conceive of a Sloth of the size and bulk of a Rhinoceros or Hippopotamus, but with bones infinitely more massive, muscles infinitely more voluminous and powerful, with a thick tail acting as a support, and forming with the hind limbs a firm tripod, while the animal thus raised upright, and exerting its enormous strength, sways the tree to and fro, and lays it at last prostrate; —and the reader will have a good idea of what this mighty devastator (the Mylodon) of the primitive forests of South America must have been." * It is an interesting circumstance, that the skull of the specimen described by Professor Owen had at some time been fractured and had healed,—the animal living long afterwards; and it is evident that these animals must have been unusually liable, from their habits, to blows from heavy falling bodies. It appears to be for the sake of meeting these accidents, that the outer and inner layers of the bones of the skull are separated from each other by large air-cells; so that the fracture of the outer table might occur without injury to the brain. The same structure exists in the Sloths; and is evidently a provision against injury from the severe falls, to which these animals must be occasionally liable, from the giving-way of the branches to which they cling.

245. The *Megatherium* was an animal nearly allied to the

* Pictorial Museum, Vol. I., p. 172.

Mylodon in structure and habits ; and several remains of it have been found in different parts of South America. Its name indicates its enormous bulk, which may be judged of from the following statement of its dimensions. Its length, when full grown, must have been 14 feet, including the tail ; and its height upwards of 8 feet. Its thigh-bone was twice the thickness of that of the largest Elephant ; its fore-foot measured more than a yard in length by twelve inches in width, and the toes were terminated by enormous claws; and the width of the upper part of the tail could not have been less than two feet. With the remains of the Megatherium have been not unfrequently found associated the relics of a bony armour, resembling that of the Armadillo ; and it has been supposed that these belonged to it. But it is now known that they formed the covering of a gigantic animal of the Armadillo kind, which will be presently noticed. The genus *Megalonyx* (or animal with a large claw) is founded on some remains which have been

Fig. 140.—Foot of Megatherium.

discovered in North and South America; from the size and form of the claw, it was at first supposed to be that of a carnivorous animal; but Cuvier rectified the error, and referred it to this group. The Megalonyx seems to have been closely related to the Megatherium in structure and habits, but to have been of less dimensions; its size was about that of an Ox; but it was much more solidly and heavily built.

246. The Insectivorous Edentata may be divided into two families, the LORICATA, or shielded animals, and the TRUE EDENTATA, or strictly toothless animals. The former comprehends the *Armadillos* and other animals allied to it; to the latter belong the *Ant-eaters* and *Pangolins*.

247. The *Armadillos* are distinguished from all other Mammalia by the inclosure of their bodies in a bony armour; this consists, first, of a large triangular or oval plate on the top of the head, which projects backwards, so as to cover the neck; secondly, of a large buckler over the shoulders, and a similar

FIG. 141.—PEBA, OR EIGHT-BANDED ARMADILLO.

buckler over the haunches: and thirdly, of a series of transverse bands which intervene between these, and are united to each other in such a manner as to allow freedom of motion to the body. Each of these separate portions consists of a number of small pieces united together, like the separate portions of a mosaic, or of a tesselated pavement. The tail, also, is covered by a series of bony rings. The limbs, which are short and thick, are almost entirely concealed by the edges of this armour;

and the skin of the under surface of the body is very tough, and is beset with long scattered hairs, of which some are also seen to issue forth between the joints of the armour. The feet are peculiarly adapted for digging, in regard both to their size and strength, and in being terminated by very strong and sharp claws. The muzzle is pointed, and the mouth small; the teeth are feeble and destitute of true roots; they are set apart from one another, in such a manner that, when the jaws are closed, those of each jaw fit into the intervals between those of the other. The tongue is smooth and slender, and is moistened with a glutinous saliva. The Armadillos are burrowing animals, and remain in their retreats during the day, issuing forth at night in search of food. They hasten to their burrows when alarmed, and seem to be peculiarly sensitive to unusual sounds; when they have gained their holes, they stoutly resist any attempt to draw them forth, by clinging to the walls with their strong claws; so that they have been known to leave their tails in the hands of the hunters, who attempted thus to secure them. When unable to gain their burrows, they either endeavour to dig a temporary place of refuge, or roll up their bodies in such a manner, that almost every part is defended by their strong coat of mail. Their food consists chiefly of insects and worms

Fig. 142.—Foot of Armadillo.

Fig. 143.—Skull of Armadillo.

but they will feed on succulent roots, fallen fruits, and other soft vegetable substances, and even on carrion when it falls in their way; they also greedily devour small lizards and serpents, and the eggs of birds which build upon the ground. Those which live near the Pampas, glut themselves on the half-putrid carcases of the wild cattle, which are slaughtered for the sake of their skins and tallow; and becoming extremely fat upon this diet, they are esteemed great delicacies (roasted whole in their shells), not only by the Indians, but also by the Spanish and Portuguese Americans. Numerous other species exist; but they are all confined to South America. The largest at present existing is the *Great Armadillo*, which inhabits Brazil and the Northern parts of Paraguay; this, although 3 feet 3 inches from the nose to the origin of the tail, must have been a pigmy in comparison with the gigantic *Glyptodon*, a fossil species, of whose armour a nearly complete specimen is contained in the Museum of the College of Surgeons, London.

248. In South America, also, is found another very remarkable animal, named the *Chlamyphorus truncatus*, or *Pichiciago;* in which several characters of different tribes are remarkably blended. Like the Armadillo, it has a tesselated shield; the consistence of which is not bony, however, being between horn and leather. This shield commences on the head, and extends over the back and haunches, dipping abruptly down over the latter, so as to look as if the body were cut off there (whence the specific name of the animal is derived); it is divided by intersecting furrows into a series of bands or strips, each of which is made up of a row of square plates; but instead of being firmly attached by its whole under-surface to the integuments beneath (as is the case with that of the Armadillo), it is connected with the back only by a ridge of skin along the spine, and with the skull by two bony prominences from the forehead. The sides and under surface of the body are covered with fine silky hair, like that of the Mole; to which animal it bears a strong resemblance also, in the form of its fore-feet, in the imperfection of its eyes (which are not visible externally), in the conical form of its snout, and in its general habits of life. It is

a native of Chili, where, like a Mole, it works out galleries in the rich soil of the valleys, living for the most part under ground in quiet seclusion, and feeding upon the insects, worms, and larvæ which it meets with in its mining operations. It is a very rare animal, being regarded by the natives themselves as a curiosity.

249. A species which forms a complete transition from this group to the next, is the *Orycteropus*, of the Cape of Good Hope; which is termed by the Dutch Colonists *Aard-vark*, or Earth-hog. This animal, which is about the size of a Badger, connects the preceding group with the toothless Ant-Eaters; having the molar teeth and strong digging fore-feet of the Armadillos; but being destitute of their scaly armour, and possessing the hairy covering and long extensible tongue of the true Ant-eaters. The Aard-vark is insectivorous in its habits,—attacking the large ant-hills of the districts it inhabits, by tearing open the roofs of the mud-walled hillocks which these insects construct; and it forms very extensive burrows at a little distance beneath the surface of the ground, which are sometimes so numerous, as to become sources of danger to horses and waggons traversing the country. When alarmed in its retreat, it mines onwards with such rapidity, as frequently to elude the search of those who would dig it out.

250. Of the TRUE EDENTATA, or *toothless Ant-eaters*, which constitute the second family of the second division of this order, there are two typical genera,—the *Myrmecophaga*, or proper *Ant-eater* of South America,—and the *Manis* or *Pangolin* of Africa and India. Both these are characterised by the total absence of teeth, by the pointed form of the muzzle and the narrowness of the mouth, by the possession of a long, slender, extensible tongue, which is moistened by an extremely viscid saliva, and by strong feet armed with sharp cutting claws. These last are adapted rather for tearing open the dwellings of the Termites, or White Ants, on which these animals feed, than for excavating burrows in the soil; when an entrance has been thus forced, the long tongue is sent down in the nest, and, when withdrawn, brings back into the mouth a large number of Ants,

which are glued to its surface by the secretion that covers it. The Ant-eaters and Pangolins differ completely, however, in external aspect, and in the nature of their covering ; though they are both furnished with very efficient means of defence against the Insects on which they make war. For, in the Ant-Eater, the whole body is covered with long shaggy hair, which forms a kind of mane along the back ; and its tail, which is of great length, is very bushy. In the *Pangolin*, (Fig. 49,) on the other hand, the whole body, as well as the tail, is covered with dense horny scales, which have an *imbricated* arrangement

Fig. 144.—Head and Foot of Ant-Eater.

Fig. 145.—Great Ant-Eater.

(each row being partly covered by the rest, like the tiles on a roof) ; and when attacked, it rolls itself up into a ball, wraps its tail over its head, and raises all its pointed and sharp-edged scales in such array, as to defy the onset of any enemy. There is a

small species of Ant-Eater, inhabiting the forests of Guiana and Brazil, which is remarkable for having only two toes on the fore-foot, and for possessing a prehensile tail, by which it can suspend itself from the branches of trees, in the bark and fissures of which it seeks the insects that serve for its food.

Order IX.—RUMINANTIA.

251. The division of the herbivorous Mammalia, which is designated by the title of *Ruminant*, forms a remarkably natural and well-defined order; by which is meant, that all the animals composing it agree in their most important characters, and differ from all those of other orders; so that there can be no doubt in regard to the position of any one of them. They seem, indeed, as if they were all constructed upon the same model,—the variations being often so trifling, that it is difficult to assign definite characters to the subordinate groups. The Camels alone constitute an exception to this general statement; for these, in the structure of their teeth, and in some other peculiarities, depart from the Ruminant type, and exhibit an approach to the order Pachydermata; but in this manner they form just that bond of connexion between the two orders, which allied groups, that are really natural, always present.

252. The animals of this group are, of all the Herbivora, those which are most completely restricted to vegetable food. We have seen that among the Rodentia, there are many which do not reject animal food, and some which greedily devour it. Of the Edentata, a large proportion live on insects; and many of these also devour animal flesh with avidity. Among the Pachydermata, too, there are several species (as we shall hereafter see), to which an animal diet appears by no means unnatural. But this is not the case with a single Ruminant quadruped; for the whole order seems destined to feed upon vegetable matter, and upon this exclusively. Some, as the Camel and Giraffe, are adapted rather for browzing upon the

leaves and young shoots of trees or shrubs; whilst the great proportion have their mouths fitted for grazing upon the herbage that covers the surface of the soil.

253. All the animals of this order agree in the absence of incisor teeth from the upper jaws,—the hardened gum sustaining the pressure of the lower incisors (which are apparently eight in number) with their broad edges. Of these teeth, however, the two outer ones, which are usually smaller than the rest and more oblique in their position, are really to be regarded as canines, somewhat modified in their form; this is evident in the Camels, in which these teeth have the ordinary form and size of canines. The molar teeth are six on either side of each jaw. Their surface exhibits crescent-shaped ridges, formed by enamel surrounding a centre of bony matter or cortical substance (ANIM. PHYSIOL., § 182). In the Camels, there are apparently five molars on each side; but a sixth molar really exists, although it is shaped like a canine tooth, and is placed immediately behind the true canine, far in front of the other molars, so as to resemble a second canine. The Camels are further remarkable for possessing canine and incisor teeth in the upper jaw; the latter are originally four in number; but the two central ones fall out early, and those which remain resemble the canines in figure. In the Musk-Deer, too, there are canines of considerable length in the upper jaw, though the incisors are absent; and the presence of canines in the upper jaw is by no means unfrequent among the males of the ordinary Ruminants,—their rudiments being also discoverable in the female.

254. The structure of the feet of the Ruminantia varies no more than that of the teeth; and where, as in the Camel tribe, we find a departure from the usual type as to the latter, we may notice it also in regard to the former. The feet are invariably terminated by two toes, whose extremities are enveloped in distinct hoofs; and the surfaces of these hoofs, which look towards each other, are so flattened, that the appearance is that of a single cleft hoof. Each toe has three phalangeal bones; and these are articulated with a single long metatarsal or canon-bone. Besides the two large or true toes, there are two small

short lateral toes in some groups, each having three phalanges, connected with a small splint-bone like that of the Horse (Fig. 167). Now in the Camels, the toes,—instead of being short and strong, and abruptly terminated by hoofs which afford a flattened surface for the limb to bear upon,—are lengthened, and are only tipped with small hoofs, the bearing surface being a large pulpy sole or pad, covered with a hard callous skin, and placed like a cushion beneath the toes. The use of this peculiar conformation will be apparent, when the habits of the Camel are considered.

FIG. 146.—BONES OF THE FOOT OF THE DEER; *t*, *ta*, first and second rows of tarsal bones; *c*, metatarsal or cannon-bone; *p*, *pi*, *pt*, phalangeal bones.

255. The name of this order is derived from the singular process of ***rumination***, which the food undergoes in all the animals composing it; as the nature of this process has been already described, it need not be here repeated. (See § 99, and ANIM. PHYSIOL., § 198). But we may stop for an instant to consider the purpose of this curious provision; which has a very interesting connection with the rest of their organisation. The Ruminantia, taken as a group, are timid, and are destitute of powerful means of defence against their foes; seeking safety in flight, when alarmed, rather than stopping to defend themselves. A large proportion of them are natives of tropical regions, where they are liable to the attacks of the larger beasts of prey. Now their food,—consisting as it does of grasses and herbage of various kinds, which contain a considerable amount of woody fibre,—requires to be thoroughly masticated, before it can be properly digested. When feeding on the pastures they frequent, they are subject to many alarms; and if they were compelled to spend a considerable time in masticating their food before swallowing it, they would often be in danger of starvation, by being obliged to leave their pasture before their wants were supplied. But by their power of subsequently returning their food to the mouth, and chewing it at their leisure, they are enabled to dispense entirely with any mastication, previously to

first swallowing it, and to feed with comparative quickness. They thus convey a store of food into the first stomach or paunch, as the Monkey does into its cheek-pouches; and then, retiring to a secluded place among their mountain fastnesses, they masticate their aliment in comparative security. Moreover, the maceration (or soaking) in the fluids of the first and second stomachs, to which the food has been subjected, causes it to be much more readily ground down, than if it were triturated immediately on being first cropped from the pasture.—In this respect, there is a remarkable analogy in the process of rumination to that of digestion in the Fowls and other grain-eating Birds (ANIM. PHYSIOL., § 200); for their food is first swallowed, then macerated in the fluids of the crop, and then triturated, before it is submitted to the true digestive process,—the only essential difference being, that this trituration is accomplished in a portion of the stomach termed the gizzard, instead of between the jaws, which in this class are destitute of teeth. This is only one of many remarkable analogies, which will be hereafter pointed out between the order RUMINANTIA among Mammalia, and that of RASORES among Birds.

256. The general structure of the Ruminantia is obviously adapted to what has been just stated of their habits. Their senses are extremely acute, and serve to indicate to them the approach of danger, as well as to direct them in their choice of food. Their eyes are placed at the side of the head, rather than in front; and in this manner they have a great range of vision, which is further extended by the *horizontally*-oval form of the pupil (ANIM. PHYSIOL., § 534), so that they can see almost as far behind as before them. The ears also are placed far back, and are very movable; so that they can be turned to catch sounds in any direction. The sense of smell seems particularly acute in these animals, chiefly in consequence of the prolongation of the muzzle, which affords a large surface for the distribution of the olfactory nerve within the nose; by its means, they are warned of the presence of an enemy at a considerable distance, especially in the direction of the wind, so that the hunters often find it necessary to approach them from the contrary quarter. As

already stated, they commonly seek safety in flight when alarmed; and the structure of their bodies usually adapts them to great swiftness of foot. Their legs are long in proportion to the size of the trunk ; and the spinal column is very flexible; both which conditions are favourable to great activity of motion. It is for the most part among the domesticated species, in which there is an accumulation of flesh and fat, at the expense of muscular firmness and vigour, that there is a deficiency in this respect. The Ruminantia are not destitute, however, of means of attack and defence, which they employ in their contests with each other, or when brought to bay by their enemies. Their strong horns are used by them to gore their opponents, and their heads to lift and toss them ; or, presenting their hind quarters, they inflict most powerful blows by kicking with their hind feet.

257. The Ruminants, of all animals, are those which are most useful to Man. They furnish him with nearly all the animal flesh which he consumes. Some of them serve him as beasts of burden; and others supply him with milk, tallow, hides, horns, and other products most important to his comfort and even to his subsistence. They are universally distributed over the globe, from the equator to regions within the arctic circle,—being most numerous, however, between the tropics; and this wide range is essentially connected with the well-being, and extensive distribution, of the Human race. From the earliest periods, certain species of this order have been domesticated, and have accompanied Man in his gradual diffusion over the globe; so that there is scarcely a spot where he exists (except the inhospitable regions tenanted by the Greenlander and Esquimaux, which do not afford the requisite pasture,—and some of the islands of the Polynesian Archipelago, into which these animals have not yet been introduced), which is not tenanted also by the Ox, the Sheep, or the Goat. Other species, again, although equally subject to Man, are formed to inhabit certain localities only, to which the peculiarities of their construction specially adapt them ; and these have consequently not spread with the others. One of these is the Rein-deer, on which the inhabitants of Lapland, a country too cold for the Sheep and

Ox, almost entirely depend for their support, their clothing and for most of the comforts and conveniences of their simple manner of living. And another is the Camel, the "ship of the desert," which traverses the burning sands, under a heavy load, patient of hunger and thirst, and which is, besides, to the wandering Arab, all that the Rein-deer is to the Laplander.

258. Notwithstanding the acuteness of the senses of the Ruminants, the development of their brain is low; and although usually docile, they do not show any considerable amount of intelligence. It may be remarked of them, therefore, as of the Rodentia, that they may be tamed rather than educated. Nor do they attract notice on account of anything peculiar in their instinctive propensities; for these are usually of the simplest kind, having reference only to the selection of food, and to the avoidance of danger.

259. As already noticed (§ 253), the *Camels* and *Musk-deer* differ from the typical Ruminants in their dentition; they also differ from them in the absence of *horns*, which are found on the heads of all the other animals of the order, in the males at least. It is by the nature of these horns, that the order is subdivided into families; the aberrant CAMELIDÆ (or Camel tribe), which lead towards the Pachydermata, and the MOSCHIDÆ (or Musk-deer), which are intermediate between these and the true Ruminants, having been first separated.—The horns, as formerly explained (§ 82), essentially consist of prominences of the frontal bone; which are sometimes *persistent*, or enduring with the life of the animal; and sometimes *deciduous*, falling off annually. 1. The persistent bone may be covered with a horny substance, which grows with it during life; this is the case with that division of the group,—including the Oxen, Sheep, Goats, and Antelopes,—to which the term *Cattle* is commonly applied. 2. The bone may be covered with a prolongation of the skin of the head, bearing hair; as is the case with the *Giraffe*. 3. The bony horn is covered with a skin, like other parts of the head, but is altogether thrown off at intervals, and replaced by a new growth, which is usually larger than the preceding; this is the case with the *Deer*.

260. The family CERVIDÆ, or *Deer* tribe, then, is distinguished from all the rest, by the possession of bony deciduous horns; covered with a soft skin, or *velvet*, instead of with horny matter; and termed Antlers. "The animals of this group, celebrated for their beauty, vigour, and speed, are spread very extensively over the globe, each quarter having its own peculiar species. To this universality of distribution, however, there are certain exceptions; none are found in Australia, and none in the southern and central regions of Africa; their place in the latter regions being supplied by the Giraffe, and by hosts of Antelopes. Hills of moderate elevation, wide plains, and forests, are the localities to which these fleet-limbed creatures give preference; none tenant the peaked ridges of the mountain-top, where the Chamois and Musk-deer find a congenial abode. They delight in a wide range of country, and trust to their swiftness of flight for safety. Most of them herd together in troops; some few live singly. It may be observed that, in general, their body is round and stout; their limbs long, sinewy, and powerful; their neck long, but very muscular; their head small and carried high; their eyes large and full; their ears ample.*" With the exception of the Rein-deer, the female is destitute of antlers; save in a few rare individual cases, analogous to those in which the hen assumes the plumage of a cock bird. These appendages are very useful for the purposes of defence, and occasionally for attack; and it is remarkable that the species inhabiting the coldest climates, are those in which the antlers are most flattened; as if they were destined to be used by the animal, like shovels, in clearing the snow from off its food. This is especially the case with the Elk, which, with the Rein-deer, inhabits the coldest parts of the northern hemisphere, in both the Old and New World; and by this character they are separated from the other Deer.—The *Elk*, or *Moose-deer*, was once tolerably numerous in Europe, but is now very rare in that quarter of the globe; it is much more abundant, however, in North America, its head-quarters being the vicinity of the great lakes, and the forests on both

* Pictorial Museum, Vol. I., p. 130.

sides of the river St. Lawrence; and in summer it frequents marshy districts, even feeding on grass that is actually submerged. This animal is as large as a horse, sometimes larger; it is rather heavy in its aspect and movements; but it possesses great power. The antlers of the male are, when fully formed, extremely large, and weigh 50 or 60 lbs. This development, however, is only gradually attained. The first year, they are not more than an inch in length, and the second they rise to a foot; but they then are simple dagger-shaped spikes, and are termed *dags*, or *prickets*. In the third year they are forked; and in the fourth, they are somewhat flattened, and have six snags or projections: the number of these goes on increasing after each change, until the horns become extremely flattened, and possess 14 branches on each side.

261. The *Rein-deer* is the only species of this family, which can be considered as domesticated; and this condition does not

Fig. 147.—Rein deer.

seem natural to it, for the domesticated individuals are smaller than the wild ones, even though better fed. In the wild state, the full-grown male is equal in size to a Stag; but it is a much less graceful animal, the neck being very short, the head carried in a line with the body, and the general aspect heavy.

The Rein-deer is strictly a polar animal; it has never been known to come further south in Europe than the Gulf of Bothnia; and from Lapland it extends eastward along the borders of the Arctic Sea, inhabiting many of the islands of the Frozen Ocean, and even tenanting Spitzbergen, where Man, with all his power of adaptation to climate, is unable to maintain a long residence. Rein-deer, differing slightly from those of the Old Continent, are found in North America; but it is probable that these are mere varieties, which have introduced themselves into the New World, by journeying along the ice that connects it with the nearest part of Asia. This valuable animal obtains its subsistence in summer from the buds and twigs of the small arctic shrubs; and in winter from a lichen, which grows beneath the snow, and which it digs up with its feet. In the wild state it is gregarious; and when domesticated, it readily associates with its fellows into large herds, which are very obedient to the directions of the herdsman. Many Laplanders possess no less than two thousand of these animals; and their wealth is estimated by the number they possess,—as that of the Patriarchs of old, and of the Arabs of the present time, by the amount of their flocks, herds, and camels.—The *Fallow-deer* also belongs to the group of Cervidæ possessing flattened horns; the species at present existing in the parks of this country, appears to have been introduced from the south of Europe, where it is occasionally to be met with in a wild state; but remains of a much larger species, now extinct, are not unfrequently met with in the peat bogs of Ireland and elsewhere, and are commonly designated as those of the "Irish Elk." The antlers, however, are much less palmated (that is, flattened and divided) than those of the true Elks; but they spread very widely apart, some of them having been found as much as thirteen feet between the tips. Judging from specimens of which many of the bones have been discovered, this animal must have stood more than six feet high, and must have been more than nine feet long.

262. The species of Deer with round antlers are very numerous, and are diffused through the temperate and tropical portions

of the Old and New World; those of temperate climates change colour, more or less, with the seasons. As belonging to this group, we may especially notice the common *Stag*, or *Red Deer*, which is a native of the forests of all Europe, and of the temperate parts of Asia; although, not being readily subservient to Man, it is rapidly disappearing as his influence extends. In England, very few of these noble animals still exist, and these are mostly in a half-domesticated state; but many still remain in the mountainous and woody parts of Scotland, especially in

Fig. 148.—Stag, or Red Deer.

the forest of Athol, in which several thousands are known to reside.—The Stag is replaced in North America, by the *Wapiti*, (commonly, but erroneously, termed an Elk), which is a fourth larger than our Stag, but nearly of the same colour. Several

other species of Deer exist in America and Asia.—The *Roebuck* is the representative of a group more nearly approaching the Goats in form and habit; for whilst the Stag delights in extensive forests, and the Fallow-deer in wooded plains, the predilection of the Roebuck is evidently for mountainous localities; and its boldness and agility in leaping are not much inferior to those of the Chamois. Of this kind several species exist in the temperate parts of Europe, Asia, and America. There are species existing in India, which are of small size, and have long canine-teeth; presenting, in these and other respects, an approach to the Musk-deer.

263. The family CAMELOPARDIDÆ includes only that very remarkable animal, the *Giraffe;* which, though it most nearly approaches the Deer in its general structure, has points of affinity, also, with the Antelopes and Camels, besides very striking peculiarities of its own. On a first glance at this animal, we notice the enormous length of the fore-legs, and the height of its neck, which carries its small, and rather delicately-formed head at a vast height from the ground,—not less, in some instances, than eighteen feet. Notwithstanding the great length of the neck, however, the number of cervical vertebræ is not greater than in other Mammalia (ANIM. PHYSIOL., § 627); and the fewness of the joints prevents the neck from being bent or arched with that elegance, which is displayed by the Swan; although nothing can exceed the gracefulness of form which this part sometimes presents. The aspect of the Giraffe, with its neck stretched up to the full, while the animal gazes around with his large beaming eyes, or plucks the foliage from the branches of the trees, browsing beneath their shade, is described as peculiarly imposing. The peculiarities of conformation which this animal displays, are all adapted to the mode of life which is natural to it, and which differs from that of any other species; for it is destined to browse upon the foliage and young shoots of trees, at a height far greater than that which any other animal can reach, whilst standing on the ground. For this purpose it is furnished with an elongated *prehensile* tongue, which is analogous in its uses to the proboscis of the Elephant,—being at once a feeler, a grasper, and an organ

of taste. With this it lays hold of the tender branches, and draws them into its mouth; being assisted by the upper lip,

Fig. 159. Giraffe.

which is endowed with great flexibility and muscular power, and projects beyond the lower. The Giraffe cannot readily bring its mouth to the ground; being obliged, in order to do so, to stretch its fore-legs widely apart, and to bend its neck into a semicircular form. It is obviously not adapted, therefore, to browse near the earth; and it seldom lowers its head to the ground,

except to drink, or to pick up some unusual delicacy. The eyes of the Giraffe are full, dark, and lustrous; and are so prominent, that they command, without the animal moving its head, a survey of the whole horizon. The ears are long, pointed, and movable; and the sense of hearing is very acute. When warned, through these channels, of the approach of danger, the Giraffe seeks safety in flight; and awkward as its movements seem, when it is slowly traversing a limited space of ground, they are far from being so on its native plains; for it is there a match for the swiftest coursers of the desert, whilst on rugged and broken ground these are utterly unable to overtake it. The peculiarity of its movements results from the shortness of its body in comparison with the limbs; so that the hind-hoofs are brought at each step as far forward, as the spot occupied during the previous moment by the fore-hoofs,—though somewhat to the outside of it, as the hind-limbs rather diverge from each other. The legs of either side move at the same time with each other, alternating with those of the opposite side, so as to give the pace termed the *amble* (ANIM. PHYSIOL., § 660). When attacked by enemies from which it cannot escape, the Giraffe defends itself by kicking; and the blows it inflicts succeed one another so rapidly, that the eye can scarcely follow the movement. The traveller Le Vaillant, from whose observations we may date our first correct knowledge of this animal, says, "I know beyond a doubt, that it often tires out, discourages, and even beats off the lion." After his dogs had brought an individual to bay, they dared not make an attack, on account of the rapid succession of kicks with which it defended itself. The horns appear never to be used in resisting an attack; although the Giraffes have been observed to butt each other with them in sport. Two varieties of this curious animal are known,—one of them peculiar to Nubia, Abyssinia, and the adjacent districts,—the other a native of Southern Africa. They have been regarded by some Naturalist as distinct species; but this is probably an error.

264. The ANTELOPIDÆ, or *Antelope* tribe, approach the Deer in their general conformation, as well as in the activity of their habits. This family, which is remarkable for the slenderness of

form and swiftness of foot of the animals composing it, contains more than seventy well-ascertained species, bearing a strong general resemblance to each other;—these are diffused through the warmer parts of the globe,—the principal part being natives of Africa, a few species inhabiting Asia, a still smaller number being found in America, and only two, the *Chamois* and the *Saiga*, at present residing in Europe. The horns, of which the *persistence* distinguishes them from the Deer, are composed of a solid bony core, which is covered with a horny sheath; this consists of fibres analogous to those of whalebone, or rather hair, running longitudinally or spirally, and agglutinated into one uniform mass. One species has four horns. (Fig. 150.) Among the true Antelopes, the family likeness is extremely strong; and it is not easy to find characters sufficiently definite for subdividing the group; but many hollow-horned Ruminants, for which no other place could be found in other families, have come to be associated with this; so that it presents a rather incongruous assemblage. For the sake of perspicuity, the family may be divided into four sub-families;—*True* Antelopes, *Bush* Antelopes, *Capriform* (Goat-like) Antelopes, and *Bovine* (Ox-like) Antelopes. Each of these will be separately, though briefly, considered.

Fig. 150.—Four horned Antelope.

265. The *True Antelopes* are remarkable for the graceful symmetry of their bodies, the length and slenderness of their limbs, and the lightness and agility of their movements. In fleetness, indeed, there are few if any animals that can approach them by speed of foot; the greyhound unaided cannot overtake them; and stratagem is necessary, therefore, in hunting them. They mostly prefer the open plains; seeking refuge in mountain fastnesses, only when they are alarmed. One of the most

graceful and beautiful species of this group, is the *Spring-bok* of Southern Africa; which derives its name from its singular habit of leaping perpendicularly, when alarmed, or as it scours the plain, to the height of several feet. This animal lives in large herds, which spread themselves over the extensive plains that occupy a large part of the interior of that country. The karroos (as these vast wilds are called) are subject to seasons of drought, in which the pasturage is completely dried up; and the Spring-boks, driven to change their quarters, literally inundate the fertile cultivated districts, over which swarm after swarm passes, like wave after wave, destroying the hopes of the colonists. When the rains begin to fall, the horde, thinned by the attacks of man and beast, begins to return to the interior; and, in a few days, the whole disappear. Mr. Pringle mentions that some of these migratory swarms with which he fell in, whitened, or rather specked, the country, as far as the eye could reach; and he estimates the numbers at one time in view, at not less than 25,000 or 30,000.—To the group of true Antelopes also belongs the *Gazelle*, so celebrated among the poetical writers of the East. This very beautiful species inhabits Arabia and Syria, where it is seen in large herds, bounding over the desert with amazing fleetness, and seeming to skim along the level plain almost without touching it. It is usually hunted with the assistance of falcons, which fly at its head and thus check its speed, giving time for the dogs to come up,—the swiftest greyhound being completely distanced by it. It is also captured by stratagem; an inclosure being prepared near a rivulet or spring to which the Gazelles resort to drink; and the herd on its approach

Fig. 151.—Spring-bok Antelope.

being driven into the inclosure, through gaps in its sides, by the shouts of the hunters and the noise of their fire-arms. When taken young, the Gazelle, though naturally so wild and timid, is readily domesticated, and becomes quite familiar. Tame Gazelles are frequently seen at large, in the court-yards of houses in Syria; and their beauty, exquisite form, and playfulness, render them great favourites.

266. The *Bush Antelopes* are of a more compact form, and have shorter limbs; hence they are animals of less activity, but of more vigour, than the true Antelopes. They live singly or in pairs, frequenting jungles, dense reed-beds, and the underwoods of forests; most of them preferring hills or mountain districts of moderate elevation. When pursued, they dive through the thicket, and quickly disappear. These also are chiefly found in the Southern and Western parts of Africa. The species represented in the accompanying figure, is found in the neighbourhood of Sierra Leone; and by the English residents there it is called the Bush-goat. It is a dull heavy animal, lurking in the thickets during the day, and resorting to the open spaces in the mornings to feed. Its back is arched, its legs short, and it has altogether somewhat of a pig-like shape; but its flesh is more esteemed than that of the more handsome and agile Antelopes. Its length is about five feet; and its height three. The horns are very short.

Fig. 152.—Bush Antelope.

267. *The Capriform Antelopes* are more widely diffused; being inhabitants of mountain ranges and hilly countries in all quarters of the globe. They are characterised by the very compact and robust form of their bodies, and by their general adaptation for a mountain life. The head is heavy, the neck short,

and the limbs strong; the horns are small or moderate; and their bodies are covered with coarse or wiry hair.—The species which inhabits Europe is commonly known as the *Chamois Goat;* it lives among the Alps, Pyrenees, Carpathian and Grecian mountains, and also the ranges of Caucasus and Taurus. "Every where it tenants the loftiest ridges, displaying the most astonishing activity. During the summer, it is only to be found on the mountain tops, or in sequestered rock-girt glens, where the snow lies unmelted throughout the year; but in winter it descends below the line of perpetual snows, to the grassy slopes, where it becomes doubly cautious and wary. Its senses of hearing, sight, and smell are extremely acute; and it scents the approaching hunter at the distance of half a league. When its fears are once excited, it bounds from rock to rock, as if to gain a view of the surrounding district, uttering at the same time a singular hissing sound; but no sooner has it caught sight of its enemy, than off it bounds, scaling the most fearful rocks, clearing chasms, and leaping from crag to crag with amazing rapidity. Its course is not stopped by a perpendicular precipice of twenty or thirty feet in depth; with astonishing boldness it takes the leap, striking the face of the rock repeatedly with its feet, for the purpose both of breaking its fall, and of directing itself more steadily to the point it aims at. It pitches on the smallest ledge, where the eye of man scarce discerns room for its foot; and it traverses with security the beetling shelf that overhangs the deepest abyss. The food of the Chamois consists of mountain herbs and flowers, and the tender shoots of shrubs: it seldom drinks, but is extremely partial to salt; and many stones are met with in the Alps, hollowed out by the continual licking of the Chamois, on account of the saltpetre with which they abound."* Other Caprine Antelopes (often designated as Goats) are found in Asia, the Asiatic Archipelago, and America.

268. We lastly proceed to the section of *Boviform* or Ox-like Antelopes, which contains species that present various degrees of relationship to the Antelopes and Oxen respectively. Some of

* Pictorial Museum, Vol. I. p. 145.

these, such as the *Nyl-ghau* of India, are closely allied to groups among the true Antelopes; whilst others have nothing of the Antelope in form or appearance, and approach the Oxen much more nearly. In general they are distinguished by their massive contour, large size, and powerful limbs; the head is usually large, the horns thick and solid, the eyes small, and the neck short and thick.—The *Nyl-ghau* is a magnificent species, standing upwards of four feet in height at the shoulder; it resides in the dense forests, either alone or in pairs; and it is a resolute and powerful animal, turning and defending itself against its pursuers with great fury, and not being tamed down by confinement. It is, however, the common prey of the Tiger.—The *Addax* is a Bovine Antelope of Africa, living solitarily or in pairs, on the borders and oases of the deserts, which occupy a large part of the centre of that continent. It is rather heavily made; and its hoofs possess remarkable breadth, to pass more easily over the fine and loose sand.—The last species at present to be noticed, the *Gnu*, is a very remarkable one, on account of the singular mixture of characters which it presents. The head and horns are those of a Buffalo; and the eyes are large, wild, and expressive of a savage and vindictive disposition. The neck with its mane, the tail, and the general contour of the body, resemble those of the Horse; whilst the well-turned and vigorous legs remind the observer of the Stag or Antelope. The chin and throat are covered with a sort of shaggy beard; while a full mane flows down from the chest between the fore limbs. The action and gallop of the Gnus are so much like those of the Horse, that a troop of them, seen scouring the plain at a distance, might easily be mistaken for Zebras or Quaggas, if it

Fig. 153.—Addax.

were not for the difference in colour. Its usual size is about that of a well-grown Ass; its height exceeding four feet. It is a native of the wild karroos and hilly districts of Southern Africa; roaming mostly in large herds, which migrate according to the season. These are not to be approached without difficulty; for they either take alarm, and retreat with great swiftness, following a leader in single file; or, if they are wounded, they turn upon the assailant, charging with great fury, and using their horns in a very dangerous manner. It is not tamed by confinement; but when taken young, it may be domesticated with the cattle of a farm, with which it associates harmlessly.

269. The animals of the family BOVIDÆ, or *Ox* tribe, are distinguished from those of the Antelope and Goat tribes, by the bulkiness of their forms and their great strength; and also by the uniform presence of horns in both sexes,—these being commonly possessed by the males only, in the other tribes. The direction of the horns, which is in the first instance lateral, then inclining upwards or forwards, is another character of distinction. All of the Ox group are gregarious in their habits; and no quarter of the globe is destitute of some free native species. Of the domesticated *Ox*, as of other animals brought completely under the subjection of Man in early times, the origin is obscure. The only existing wild race with which it can be reasonably considered identical, is one of which a herd is preserved in Chillingham Park, and another at Craven. It may be doubted, however, whether these herds are really the remains of an original wild race; or whether, like the wild horses of South America, they are not the descendants of individuals, which have once been in subjection, and which have since returned in part to their original condition. The latter appears most probable; since the skeleton of these cattle bears a much closer resemblance to that of the domestical Ox, than it does to that of any wild species either at present existing, or known by its remains to have existed in past times. It is well known that several *breeds* or races of the Domestic Ox exist, differing very widely from each other, not only in stature, but also in the proportions of the several parts of the body. None of those known in Europe,

however, are so remarkable as the *Zebu* or *Brahmin Ox*, distinguished by the large fatty hump which it carries on its back; this breed is spread over India, China, and the Indian islands, and also inhabits Madagascar and the eastern coast of Africa.

Fig. 154.—Zebu or Brahmin Ox.

Various races of this animal,—differing in size from that of our largest cattle, to that of a young calf,—are found in these countries; they are extremely docile, and are subservient to the same uses in their native climates as those to which we put the Ox in this country; the larger breeds surpass ours in strength, and are far more active. The hump increases very much in those individuals which are plentifully supplied with food, and lead an indolent life; whilst it diminishes in those which are harder worked and poorly fed. There is a doubt amongst Naturalists, whether the Zebu is of the same original stock with the domestic Ox, or of a different species; but the former is probably the case.

270. The history of the Human race seems to show, that it is to central Asia, rather than to the wild forests of central Europe, that we are to look for the original types of our domesticated races of animals. Nevertheless some Naturalists are

inclined to regard our domestic Ox as the descendant of a wild species, which formerly inhabited the forests of central Europe, and which was described by Cæsar and other ancient authors under the name of the *Urus*. This appears from historical records to have been far superior in size, and especially in the dimensions of its horns, to any wild Oxen now existing in Europe; and these accounts are confirmed by the fact, that fossil skulls of very large dimensions, with the cores of massive horns, are abundant in the newer strata of Europe. In a specimen found at Melksham, the distance between the ends of the cores was four feet; and the space between the tips of the horns must of course have been much greater: from this we may form an idea of the size of the ancient Urus, which was doubtless described truly as a savage, untameable animal. The Urus of modern Natural-

Fig. 155.—European Bison.

ists is the *Aurochs* or *European Bison*, which inhabits the forests of Lithuania; it is an animal of great bulk and strength, and of considerable ferocity. Such is its innate wildness, that

it has never been completely tamed; it is afraid neither of the Wolf nor of the Bear, and assails its enemies both with its hoofs and its horns. It is extremely shy, and avoids the approach of Man; which, from the acuteness of its smell, it can detect at a great distance: but, when accidentally and suddenly fallen in with, it will passionately assail the intruder.—The *American Bison*, commonly but erroneously termed the *Buffalo*, is very nearly allied to the preceding, both in structure and habits; it is rather smaller, however, in stature. It was formerly spread more extensively than at present; but it still exists in the prairies of Louisiana, associating in vast herds, of which some have been estimated to contain 20,000 individuals.

271. The true *Buffaloes* are inhabitants of the Old World only, and were originally restricted to Asia and Africa, although they have been introduced into the South of Europe. The common species was originally a native of India, where it has long been domesticated, and where its services as a beast of draught and burden render it extremely valuable. From India it has spread into China, Siam, the Indian Archipelago, &c.; and also into Egypt, Greece, Italy, and Spain; in all of these countries there are races which have almost returned to a state of nature, whilst others are brought under subjection to Man. The Buffalo differs materially in its form and general aspect from the Ox; being a heavier and more clumsy-looking animal, but also a more powerful one. The hide is covered sparingly with black wiry hair; and the horns, which often attain a large size, are first directed backwards, and then turn up sideways. In its native state, it is savage in its temper; and it does not completely lose its ferocity when domesticated, having been known to turn upon its keeper and destroy him, when irritated by overwork or unkind usage. It is sufficiently strong to be a match for the Tiger, which is often worsted in the conflict. The favourite residence of the Buffalo is the hot morass, in which it lies wallowing for many hours together during the heat of the day: and it inhabits the most pestilential parts of Italy, seeming to prefer the spots in which the *malaria* (or noxious exhalations), so injurious to Man and to most other animals, prevail. These habits

make it especially useful as a beast of burden in such situations; for it will pass through morasses, rivers, and torrents, in which

Fig. 156.—Indian Buffalo.

horses, mules, or oxen would be useless; dragging large heavily-laden carts, with enormous wheels, whilst itself chest-deep in mud. There are numerous races of Buffaloes in India and elsewhere,—some of them wild, and others domesticated,—which differ considerably from the common species; but it is doubtful whether several of these are anything else than varieties, analogous to those widely-different ones which we meet with among domestic Cattle. Of these we may notice the *Arnee*, remarkable for the large size of its horns, which often measure from four to six feet in length, and ten feet between the tips.—The last species of this family, claiming especial notice, is the *Musk-Ox*; which is an inhabitant of the coldest regions of North America, and derives its name from possessing strongly the musky odour, which is common to the whole group, and which is particularly noticeable in the European Bison. This animal scarcely equals in size the smallest of the Highland cattle; but it appears larger than it really is, from the profusion of long matted woolly hair, with which it is covered, and which hangs on each side almost to the ground. The form of its horns resembles that which is seen in the Cape Buffalo. Though its limbs are short, it is a fleet and active animal.

272. Although from the family *Antelopidæ*, we were led by the Gnu and other Bovine species to the family *Bovidæ*, the family we have now to consider,—the CAPRIDÆ or *Sheep* and *Goat* tribe,—is equally connected with it, by the Caprine Antelopes formerly described (§ 267). This family differs from that of the Antelopes, by the structure of the core of the horns, which is solid in the latter family, whilst in the Capridæ and Bovidæ it is more or less hollowed into cavities or cells. Between the Oxen and the Sheep and Goats, the principal differences are such as have reference to their size and habits. Between the *Goats* and the *Sheep*, the differences are extremely trifling; for although the distinction is obvious enough in our domesticated breeds, it is almost imperceptible when we compare the wild species and the domesticated races of other countries.—The original stock of the *Common Goat*, as of other races of animals early subjugated by Man, cannot be distinctly traced; but it appears to be the same with that of numerous half-domesticated breeds, which abound in Asia. Of these, the one to which it probably approaches most nearly, is the *Syrian Goat*, whose long hair was employed at a very early period for the manufacture of stuffs; whilst the milk yielded by the females has been a most important article of food to the inhabitants of that region. The *Angora Goat* has the hair

FIG. 157.—ANGORA GOAT.

longer and more silky; whilst the general aspect of the animal more resembles that of the Sheep. The length and silkiness of

the hair is still more remarkable in the Cashmir Goat, a native of Thibet; from this material are woven the Cashmir shawls, that are so highly valued in Europe. The quantity of wool produced by each goat is not above three ounces; and ten goats are required to furnish sufficient wool for a shawl, a yard and a half square. The wool collected in Thibet is sent to Cashmir, where it is manufactured; and a long and toilsome journey must be traversed before the shawls can be transmitted to Europe. Attempts have been made, but with what success cannot yet be known with certainty, to naturalise the Cashmir Goat in Europe; the most promising result has been obtained by *crossing* the Thibet and Angora breeds,—the mixed race being in all respects superior to both the parent stocks, and producing in one season thirty ounces of hair, finer and longer than that obtained from either of them.

273. All these varieties have small horns; and they are thus distinguished from the *Ibex*, a genus in which the body is more robust, and the horns very large. The Caucasian Ibex, a bold and powerful animal, is an inhabitant of the alpine heights of Europe and Western Asia; and its chase is as arduous as that of

Fig. 158.—Jemlah Ibex.

the Chamois. When hard pressed, the Ibex has been known to turn upon its foe with impetuous rapidity, and to hurl him head-

long down the steep rocks or abrupt precipices. It is also said that the Ibex will precipitate itself fearlessly down precipices, always falling on the horns, the elasticity of which secures it from injury. Several distinct species are found among the mountain-ranges of Africa and Asia; most of them closely resembling each other in structure and habits. One of the handsomest is the Jemlah Ibex, an inhabitant of the Himalaya mountains. Its height is thirty-three inches; its head is finely formed, full of beauty and expression, and without the least vestige of a beard; and its horns are peculiarly massive at the base. It lives solitarily or in small herds; and though bold and pugnacious, it is easily tamed.

274. The *Sheep* is the animal of whose subjection to Man we have the earliest notice; "Abel was a keeper of sheep." Consequently, we must look to Western Asia as the original habitation of the race; and possibly some wild species, from which it descended, may still exist on the slightly-explored plains and table-lands of that region. That this animal should have become greatly changed in its characters from the original stock, is not to be wondered at; for of all our domesticated animals, it is probably the one in which the influence of external circumstances shows itself most evidently. Thus, the finest South-down Sheep imported from Britain into the West India Islands, become quite lean in the course of a year or two; and their thick woolly fleece is replaced by a covering of short, crisp, brownish hair. It has been noticed as a character distinguishing the domesticated sheep from all wild species at present known, that the tail in the latter is always very short, whilst the domesticated breeds generally, if not always (when unmutilated), possess tails which nearly reach to the ground. In the Egyptian and Syrian sheep, this appendage often acquires an enormous size, sometimes attaining a weight of 70, 80, or even 100 lbs.; and in order to prevent inconvenience to the animal, it is not unfrequently supported upon a sort of little cart. Now although there are several instances, in which domestic animals lose part or the whole length of the tail possessed by their original wild stocks, there are none in which an originally short tail has been converted into a long

one; and thus the difference is of considerable importance. The *Argali*, or wild Sheep of Siberia, which inhabits the mountains of Asia, and attains the size of the Fallow Deer,—and the *Moufflon* of Corsica, a smaller species inhabiting the mountainous parts of Corsica and Sardinia, but not confined to them,—have been supposed to be the original stock of the domestic Sheep; but, for the reasons already mentioned, this is probably an error. In these and other allied species of wild Sheep, some of which are found in all quarters of the globe, the body is covered with a harsh kind of hair, having beneath it, at its roots, a short spiral wool, which in winter becomes longer and fuller. In some neglected breeds of the common Sheep, the wool becomes mixed with long hairs, which more or less obscure the wool; and in the Cashmir and Angora Goats, the long outer garment is hair, and the short under-coat exquisitely fine wool. Hence it may be reasonably inferred that, whatever the original stock of the common Sheep, its coat resembled that of the wild species at present existing; and that in the early ages of Man's history, the shepherds must have selected those individuals for breeding, in which the wool predominated; by following up which system, the wool-bearing breed would be at length permanently established. In the same manner, the silky-haired varieties of the Goat were probably introduced; and the establishment of any new breed must take place upon similar principles (§ 111).

275. The preceding families include all the animals which agree in the general characters of the Ruminant Order, as formerly stated (§ 259); and there now only remain two *aberrant* groups; the MOSCHIDÆ, *Musk-Deer* tribe; and the CAMELIDÆ or *Camel* tribe. Of these, the latter conduct us towards Pachydermata, with which they have been associated by some naturalists; whilst the former are intermediate between the Camels and the true Ruminants.

276. The family MOSCHIDÆ takes its name from the circumstance, that the peculiar strongly-odorous substance termed *Musk* is obtained from one of the species which it includes; and with this, other animals nearly allied to it in structure, but not producing musk, are associated, on account of the correspondence in

their characters. The Moschidæ closely resemble the Deer in general form and appearance; but they resemble them in miniature; for, with the exception of the true Musk, which equals a Roebuck in size and stature, the rest are extremely small, some of them not exceeding a Hare in magnitude. They are extremely beautiful animals, and are very graceful and animated in their movements. The family is distinguished, as formerly stated, by the absence of horns; and by the presence, in the upper jaw of the male, of long canines, which project downwards, and come forwards between the lips. Moreover on each foot there are two accessory toes, more complete than those of the ordinary Ruminants, each having its own metacarpal or metatarsal bone.

277. The true *Musk-Deer* inhabits the great extent of elevated country which occupies a large part of central Asia; being common to Nepal, Boutan, Thibet, and the districts adjacent to the North of India and to China; and being abundant also in the Altaic range, near Lake Baikal. It is covered with a long stiff inelastic fur, the hairs of which grow erect, instead of lying flat upon the body; and the presence of this substantial covering sufficiently indicates the adaptation of the animal to a cold region. The Musk is procured from the male only; and is the peculiar secretion of a glandular pouch, situated at the hinder part of the belly; from the high price of this perfume, and the ease with which it is adulterated (especially when fresh), it very seldom reaches Europe in a pure state. The habits of the Musk-Deer closely resemble those of the Chamois; it exhibits peculiar activity and strength in its movements, and is very shy of Man; nevertheless it falls a prey, in large numbers, to the hunters who pursue it for the sake of its costly perfume.—The

Fig. 159.—Musk-Deer.

other Musk-Deer, to which the general term of *Chevrotains* is given, are inhabitants of Ceylon, Java, Sumatra, and Southern India; and are adapted to a forest rather than to a mountain life. They are very small, peculiarly elegant in their appearance and movements, timid and wild in their native haunts, but mild and gentle in captivity, to which they soon become reconciled. The *Napu* of Java and Sumatra is particularly interesting, as having the smallest blood-corpuscles of any animal at present known. (ANIM. PHYSIOL., § 229). No true Musk-Deer is known to inhabit America; two species which have been described as such, being in reality the young of the Deer of that country.

278. We proceed lastly to the family CAMELIDÆ, which includes, with the *Camels* and *Dromedaries* of the Old World, the *Llamas*, which may be considered as representing them in the New. The peculiarities which distinguish the animals of this family from the ordinary Ruminants, have been already mentioned (§ 253, 254); these peculiarities for the most part show an approach towards the Pachydermata; and this is indicated, also, by the greater heaviness in the form and movements of the body, which contrast strongly with the grace and elegance of the Ruminantia in general. "There is something strange and imposing in the aspect of the gaunt and angular camel, destitute, as it confessedly is, of grace and animation. We are amazed at its height, its uncouth proportions, its long thin neck, its meagre limbs, and the huge hump on its back, which conveys the idea of distortion. Quietly it stands in one fixed attitude, its long-lashed eyelid drooping over the large dark eyes; it moves—and onward stalks with slow and measured steps, as if exercise were painful. To complete the picture, it is covered with shaggy hair, irregularly disposed, here forming tangled masses, there almost wanting. Its thick mobile upper lip is deeply divided; its feet are large and spreading, the toes being merely tipped with little hoofs.*" There are two species of this animal; the *Bactrian*, or *two-humped;* and the *Arabian*, or *one-humped*. Both are completely domesticated. The former is employed chiefly in Central Asia; the

* Pictorial Museum, Vol. I., p. 115.

latter in Arabia, North Africa, Syria, Persia, &c. The two-humped Camel is larger and stronger, being capable of sustaining

Fig. 160.—Bactrian Camel.

above 1000 lbs. weight; and is best adapted for rugged ground. But the Arabian Camel is most fitted, by its great power of enduring hunger and thirst, and by the patience of its disposition, for traversing the desert plains, whose expanse of barren land interposes a more effectual barrier between the districts it divides, than that of the rolling ocean. Well, therefore, has the Camel, which furnishes the only means of carrying on intercourse between countries thus separated, been termed "the Ship of the Desert."

279. The elastic cushion, which extends between and beneath the toes (§ 254) of the Camel, spreads at each step, according to the pressure made upon it, and thus affords a firm footing even upon sand, unless this be extremely loose; whilst the callous skin with which it is covered, prevents the animal from sustaining inconvenience from the heat of the surface on which it treads. Similar callous surfaces are to be seen on the chest, and on the joints of the fore and hind limbs; and it is upon

these that the animal rests, when it takes its repose, or kneels down to be loaded. These natural cushions are not produced by the habit of kneeling, as some have supposed; for the young animal is born with them. The elevation of the Camel's head, and the acuteness of its sight and smell, enable it to discern the green oasis, and to scent the refreshing water, at a great distance. The eye is shielded from the intense glare of light, by a prominent overhanging brow, and by long eyelashes; and the nostrils are so constructed, as to be closed by the animal at pleasure, so as to keep out the fine sand, which is continually being driven by the wind. Its natural food consists, not of the meadow herbage and rich pastures in which most of the Ruminants delight, but of thorny shrubs, date-leaves, and the leaves and branches of the tamarisk; these, when it meets with them, together with dates, beans, and cakes of barley, provided by its master, constitute its support during its toilsome journey. Hence, we see the utility of its strong incisors, its canine teeth, and its canine-like molars, which enable it to browse on the coarsest shrubs with ease; whilst its long prehensile lip, like the tongue of the Giraffe, serves to draw the twigs and leaves to its mouth, or to hold the tuft of herbage which is undergoing mastication.

280. When the Camel is insufficiently provided with food, its hump gradually diminishes in size; this results from the consumption of the fat of which it is composed; which is used up, when other materials are deficient, for the maintenance of respiration,—just like the thick layer of fat, with which hybernating animals usually become covered during the autumn. The Arabs are well aware of the importance of the hump; and are solicitous about its state, when about to commence a journey. When it has been much exhausted, three or four months of repose and copious nourishment are required to restore it to its usual condition. The peculiar construction of the Camel's stomach enables it to dispense with a frequent supply of water, —a store of liquid being contained in the cells in its wall. The degree in which it can sustain abstinence from fluid, depends, however, in part upon the habit of the particular breed, and in part upon the nature of its food. The Arabian Camel can dispense

with water until the fourth or even the fifth day; and in spring, when the young herbage is succulent, the journey across the great Syrian desert, from Damascus to Bagdad, occupying twenty-five days, may be performed without any water being required by the Camels. In the heavy caravans which traverse the desert for mercantile purposes, each Camel is loaded with from 500 to 800 lbs., and the rate of travelling does not exceed $2\frac{1}{2}$ or $2\frac{3}{4}$ miles an hour, kept up for eight hours a day; but a lighter caravan will travel somewhat more quickly, and will continue the march for nine or ten hours daily.

281. The *Dromedary* is a lighter *variety* of the Arabian Camel, bearing much the same relation to the ordinary Camel, as a Race-Horse or Hunter does to a Cart-Horse. It is used principally for journeys in which dispatch is required, and carries only a single rider, or a very light burthen. But the quickness of its journeys depends not so much upon the rapidity of its rate of movement, as upon its power of uninterruptedly continuing a moderate pace for a long time together. Urged to a gallop, it cannot maintain its pace for half-an-hour, and is easily distanced by the Horse; but it can maintain a trot, at the rate of from 6 to 8 miles an hour, for 24 hours consecutively: and a gentle and easy amble of from 5 to $5\frac{1}{2}$ miles an hour, which is the favourite pace of the Dromedary, can be kept up by it for several days and nights almost uninterruptedly. It appears that there is a swift breed of the Bactrian, or two-humped Camel also; which is in request in China. All these animals are remarkable for their docility, and for the patient endurance which they manifest. Even when overloaded and fatigued, or when the load is inhumanely laid on sores or wounds, the animal neither refuses to rise, nor attempts to cast off its burden; but merely complains of the injustice by crying out; and his suffering must be extreme for him to complain at all. Besides its uses as a beast of burden, the Camel affords sustenance, by its flesh and milk, to the people who possess it; and also hair for the manufacture of cloth.

282. The *Llamas* of South America bear a strong general resemblance to the Camels in form and structure; but they are of much inferior size. They further differ in the absence of the

hump, and the want of water-cells in the stomach; as also in the conformation of the foot. This consists of two toes, completely divided, each with a rough cushion beneath, and provided at the end with a strong short hoof; the hoofs are pointed at the tip, and hooked downwards somewhat like a claw. This form of the foot is as completely adapted to the natural habitation of the animal, as is that of the Camel; for the Llama is destined to live among the rough and rocky Cordilleras, the craggy sides of which it traverses with a free and fearless step, deriving great assistance in climbing from the hooked form of its hoofs. There appear to be three species of these animals, the *Guanaco*, *Paco* or *Alpaca*, and the *Vicugna*. The first of these is supposed to be the wild state of the species, which, when domesticated, is called the *Llama*. It still exists in a wild state, however, on the highlands of Peru and Chili. In its domestic state, the temper of the Llama is characterised by the same docility and patient endurance as that of the Camel. At the time of the Spanish invasion, it was the only beast of burden possessed by the inhabitants of South America, and was kept in immense numbers for the purposes of traffic, and also for food; its skin, also, was prepared as leather, and its wool spun and manufactured into cloth. It was estimated that 300,000 were constantly employed in the transport of the ore from the mines of Potosi alone; the ordinary load of each Llama was about 80 or 100lbs.; and its rate of travelling with this burthen over rugged mountain passes, was from 12 to 15 miles a day. At the present time, however, the Horse, the Ass, and especially the Mule, which have been introduced from Europe, have for the most part superseded the Llama as beasts of burthen, though it is

Fig. 161.—Foot of Llama.

still employed in some places; whilst the introduction of the Sheep, the Goat, and the Ox, has rendered it less necessary, as affording either food, leather, or wool. The *Paco* or *Alpaca*, and the *Vicugna*, inhabit the more elevated parts of the mountain ranges, living almost on the borders of perpetual snow. They are remarkable for the fineness of their wool, which has an almost silken texture; and they are much in request on this account. There is little doubt that they might be introduced into this country, and might be profitably naturalised in the mountain districts of Wales and Scotland; where the temperature, and the character of the herbage, resemble those of their native residence.—Fossil bones of a species of Llama, which must have fully equalled the Camel in size, have been found in South America; this was probably an inhabitant of the plains.

283. In addition to the species of fossil Ruminants of which mention has been already made, it may be here stated, that numerous species of Deer and Oxen occur in the caverns and bone-beds of various parts of the world; especially in the most recent of the *tertiary* series of strata. The Camels and Antelopes also had their representatives in the ancient world; and it would appear that the latter were much more widely diffused than at present. Few remains, however, have been found, that show any remarkable differences from the genera at present existing; and in this respect the fossils of the order Ruminantia are strongly contrasted with those of the Edentata and Pachydermata. The most distinct fossil form yet discovered is that of a South American Ruminant, to which the apellation *Leptotherium* has been given. In the lightness of its skeleton it rivals the most agile of the Antelopes; but it departs from that group, as well as from all others, in the details of its structure. The remains of two species have been found; one of them being less than the Roe, and the other larger than the Stag.

Order X.—PACHYDERMATA.

284. The order Pachydermata, which includes all the ungulated or hoofed true Mammalia that do not ruminate, derives its name from the thickness of the skin, which is usually so remarkable a character of the animals it comprehends,—as for instance, in the Elephant, Hippopotamus, Rhinoceros, and common Hog. A very cursory glance through the group of animals thus brought together, serves to show that they are not by any means so closely allied, as are those of the preceding order. The Elephant, the Horse, and the Hog, for example, differ so much from one another, that we might be almost led to regard them as types of distinct orders; or at any rate we should be forced to suppose that the continuity or completeness of the series had been broken into. The interruption of the chain becomes still more striking, when we pass from any of the animals already named, to the Dugong and other Whale-like species, which many distinguished Naturalists have arranged in the same order. But the researches which have been made, for some time past, into the structure of the animals that formerly covered our globe, as made known by their fossil remains, have been peculiarly successful in their results as regards this order; —furnishing, in a large proportion of cases, the very forms which are wanting as links in the chain, and which, when placed in their proper position, give order and completeness to that, which previously seemed a confused assemblage of dissimilar creatures: whilst the animals to which these remains belonged, have their strange forms accounted for, and their striking peculiarities explained, when they are viewed as the intermediate links between groups, which, as known only by the animals at present existing, seem far apart from each other.

285. For the reasons just specified, it is impossible to assign any other general character to the order, than those which have been already given. The conformation of the teeth, and the structure of the extremities, which elsewhere afford such import-

ant marks of resemblance, are here so various, as to require a separate description for each family; it can only be stated regarding the former, that they are chiefly formed for a vegetable diet (though some species are omnivorous); whilst the extremities are constructed for support only,—the clavicles being absent,—the bones of the fore-arm consolidated, so that the power of rotation is altogether lost,—and the toes included in a callous skin, or in proper hoofs. The order may be subdivided into four sections; distinguished by the following characters:—1. The ANISODACTYLA, in which there are several hoofs, forming a single series round the bottom of the foot.—2. The ZYGODACTYLA, with feet composed of two principal hoofs on which the animals walk, separated as in the Ruminants by a cleft.—3. The SOLIDUNGULA, in which the foot has but a single entire hoof.—4. The SIRENIA, or CETACEA HERBIVORA of many authors, in which the posterior extremities are wanting, and the anterior converted into paddles.

286. Of the *Anisodactyla* the first family is that of the ELEPHANTIDÆ, or *Elephant* tribe; and this at present consists of but a single genus. The *Elephants*, of which only two species—the Asiatic and the African—at present exist, are distinguished, not only by their proboscis, but by the absence of front teeth in the lower jaw, and by the possession of two enormous tusks, which project downwards from the upper. These, like the long incisors of the Rodentia, grow from a pulp which is continually forming new ivory (ANIM. PHYSIOL., § 177); and may be regarded as closely analogous to the teeth which are characteristic of that order. The analogies between the largest and the smallest of the terrestrial Mammalia do not, however, stop here. They may be traced, also, in the structure of the molar teeth, which are formed of alternating vertical plates of enamel, bone, and crusta petrosa, arranged transversely to the jaw, as in the Rodentia (§ 216). These grinders succeed one another, from behind forwards,—each tooth, as it is worn, giving way to another, which is pushed into its place; so that the Elephant may have one, or two, of these large grinders on each side, according to the period of their development. The molars are said to be thus changed eight times; the first tusks of the young

Elephant are shed, however, like the milk teeth of other Mammalia, and are not renewed more than once. In the continual growth of the molars, there is another analogy between the Elephants and some sections of the Rodentia (§ 231) ; although

Fig. 162.—Elephant.

the mode of renewal is different. The African and Asiatic species differ from each other in the size of the tusks, which are much shorter in the latter than in the former ; and also in the arrangement of the plates of enamel in the molar teeth, the ridges of which are nearly parallel in the latter, whilst they are lozenge-shaped in the former. The trunk, which is the peculiar

distinctive character of these animals, is nothing else than the nose or snout, enormously prolonged, and principally composed of forty thousand or more small muscles, interlaced in every direction, which give it an extraordinary degree of flexibility, and render it a most efficient organ of prehension. We shall hereafter see that approaches to this structure are to be found in other animals of the order. The large size of the muscular mass by which the trunk is connected with the head, requires an extensive bony surface for their attachment; and this is provided for by the peculiar conformation of the skull, the outer plate of which is separated from the inner by a number of large bony cells, so as to give to the exterior of the head a much greater size, than is required for the mere enclosure of the brain. The trunk, which is perforated along its whole length by the nostrils, has at its termination a small finger-like appendage, which serves to pick up small objects, and also as a feeler; and the sense of touch appears to be here peculiarly delicate. This wonderful organ serves a great variety of purposes. The shortness of the neck, rendered necessary by the enormous weight of the tusks (of which a single one has been known to weigh 350 lbs, the *ordinary* weight of the pair being probably 4 to 5 cwt.), is fully compensated by this instrument; for by means of it, the Elephant collects the herbage on which it feeds, and carries it to its mouth; with this he strips the trees of their branches, or grasps his enemy and dashes him to the ground; and with this too he takes up the fluid which he requires, sucking it into the extended nostrils (from which it is prevented from passing backwards, by a sort of valve placed where they pass into the skull), and then discharging it into his mouth or over the surface of the body. The tusks are useful, not only as weapons of offence and defence, but also to root up small trees, and to tear down the branches of larger ones, either to obtain the leaves as food, or to make a passage for the bulky body of the animal through the tangled forest.

1987. The Elephant is the largest of the terrestrial Mammalia; for although the Giraffe carries his head at a greater elevation, the height of his body is far exceeded by that of the

Elephant, the back of which has been known to stand more than 12 feet from the ground. In point of bulk, the Rhinoceros and Hippopotamus are the only existing terrestrial animals, that can approach the Elephant; though some other animals now extinct must have considerably surpassed him. The enormous weight of the body could only be sustained by legs of the most solid construction; and accordingly we find that these have the aspect of straight columns, the joints being so formed, that each bone rests vertically upon the one beneath it. The Elephant derives much dignity from its colossal bulk and vast powers; but there is no grace in its contour, and its movements are heavy and ungainly. From the earliest times, this noble beast has been brought under subjection to the human race; to whose use it is particularly adapted, not only by its vast strength, but also by the extraordinary combination of docility and intelligence which it presents. Like the Dog and Horse, it seems peculiarly susceptible of the influence of Man, and disposed to attach itself to him. As an instance of its enormous power, it may be mentioned that an Elephant, applying its forehead to the muzzle of a piece of cannon, will urge it through a bog, from which hundreds of cattle and men could not drag it; or, winding his trunk round the gun, it will lift the piece, whilst the cattle and men pull it forwards. The African species is not at present tamed by Man, being pursued solely for its tusks; but this was the species known to the ancient Romans.

288. A third species of Elephant, commonly known as the *Mammoth*, formerly existed in Northern Asia in great abundance; as is proved by the vast number of tusks and bones which are found buried in the frozen soil of Siberia. The tusks form a regular article of commerce, and are employed throughout Russia as the ordinary ivory of the turner. A complete carcase of the animal was found at the beginning of this century, frozen up in the ice at the mouth of the river Lena in Siberia; the flesh being in such good preservation that bears and dogs fed off it. The skin was covered with two kinds of hair,—one long, scattered, and bristly,—the other short and closely set; so that this animal was evidently adapted for climates much colder than

those which the Elephants of the present day inhabit. Still it cannot be imagined that the temperature of Siberia, at the time when the Mammoths were the denizens of its wilds, was as cold as at present; since there would not have been a sufficient amount of vegetation for the support of any numbers of these immense Quadrupeds. And the belief that, from some Geological causes, a change of climate has taken place in that region

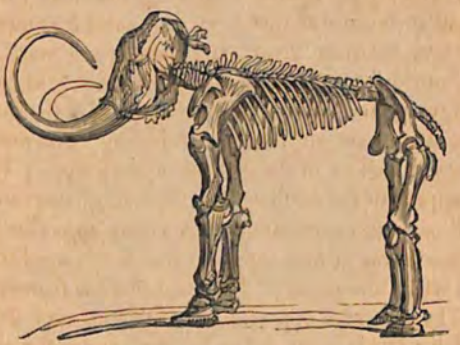


Fig. 163.—Skeleton of Mammoth.

since they inhabited it,—to which change the extinction of the race is due,—finds confirmation from the corresponding facts already stated (§ 206), regarding the former inhabitants of our own country. It is probable that many other complete carcases of the Mammoth may still remain, buried beneath the ice and frozen soil of Siberia. In its general structure, and in the arrangement of the plates of enamel in its molar teeth, the Mammoth approached the Asiatic Elephant, more nearly than the African species; the most obvious difference is the large size of the *alveoli*, or sockets for the tusks, and the greater curvature of the tusks.—Numerous remains of other species of Elephants are found in almost every part of Europe, and also in America; they are usually buried in the most recent and slightly-consolidated *strata*,—such as the *alluvium* filling the bottom of valleys or forming the borders of rivers, the mud of certain caverns, the *crag* formation of the eastern side of our island, and other fresh

water deposits of the newest tertiary series. They are commonly associated with remains of other animals; of which some may be referred to existing genera; whilst many (some of which will be hereafter noticed) present forms, of which we have not any representatives amongst the races now living.

289. Nearly allied to the Elephants is an extinct genus, termed the *Mastodon*, which was characterised by the form of its molar teeth. These, instead of having the enamel disposed in ridges, had their crowns raised up into conical eminences, with deep furrows between them; and these were worn down by friction, into disks of various sizes, very much as in the Pig, Hippopotamus, and other Pachydermata. In the young state, moreover, there were small tusks projecting downwards, in the *lower* jaw (as well as in the upper) of both sexes; but both of these disappear in the adult female, and only one remains in the male. From the examination of a young specimen possessing these tusks, it was at first supposed that it belonged to a distinct genus, to which the name of *Tetracaulodon* (or four-tusked) was given. The *Mastodon giganteus*,—of which a very fine skeleton was recently (1842) exhibited in London, under the name of the Missouri Leviathan,—must have considerably exceeded in size the largest Elephants of the present day. Its remains are confined to the American continent, and are very abundant in some parts, especially in the saline morass popularly termed the Big Bone Lick. Some curious traditions exist amongst the North American Indians regarding the colossal animals, of the existence of which these bones now furnish the only evidence. Some of them believe that they existed contemporaneously with men of a corresponding stature, but that both these gigantic races were destroyed by the thunderbolts of the Great Being, whilst others, still attributing their destruction to the same source, suppose that the male leader of the herd escaped to the Great Lakes, on the borders of which they believe him to be still living. Several other species of Mastodon, however, have been distinguished by their remains; of these some were natives of the Old World, and probably even of Britain: but they were for the most part considerably smaller than the gigantic Mastodon of North America.

290. Of the second family, to which the name of TAPIRIDÆ, or the *Tapir* tribe, may be given, no members exist in Europe at the present time; but fossil remains of numerous species, some of them of great size, exist in some localities. The whole family is herbivorous, but in confinement they seem occasionally to be indifferent as to the nature of their food. Of the *Tapir*, three species are at present known; two of them being natives of South America, whilst the other is an inhabitant of some of the larger islands of the Eastern Archipelago. In its general form and contour, the Tapir reminds us of the Hog; but it is at once distinguished by its snout, which is lengthened into a flexible proboscis, that looks like the rudiment of the trunk of the Elephant, and is sufficiently prehensile to grasp fruit or bunches of herbage, or to serve as a hook for drawing down twigs to the mouth (Fig. 57). The anterior feet have four toes, but the posterior only three; and these have only their tips cased in small hoofs. The incisor teeth are six in number; the canines small; and the molars are seven on each side of the upper jaw, and six in the lower. The common American species, which is between three and four feet in height, and from five to six in length, is very extensively spread throughout the warmer regions of South America, where it inhabits deep forests, leading a solitary life, and going in search of food at night. Its enormous muscular power, and the tough thick hide which defends its body, enable it to tear its way through the underwood in whatever direction it pleases; when thus driving onwards, it carries its head low, and, as it were, ploughs its course. It is very fond of the water, and resorts to it when wounded. Its disposition is peaceful and quiet, and it never attempts to attack either man or beast, unless hard pressed; it is capable of defending itself vigorously, however, and inflicts severe wounds with its teeth. The Tapir is occasionally domesticated in Cayenne, and is harmless and familiar in its habits. The other South American species is an inhabitant of the most elevated regions of the Andes, and is covered with long, thick, black hair. In some of its characters, it approaches to the fossil *Palæotherium*.

291. The Indian Tapir closely resembles its American rela-

tives in conformation and habits, but is considerably larger than either of them, often measuring seven or eight feet in length. Its skin is closely covered with rather stiff hair, which, instead of presenting the dusky bay tint of the common American species, is of a black colour on the anterior parts of the body and limbs, and white on the hind quarters, the two colours being separated by a sharp line of demarcation. It is found principally in Sumatra, Borneo, and the peninsula of Malacca, but probably enjoys a more extensive distribution upon the Asiatic continent, as representations of it are by no means uncommon in Chinese books and drawings. In Borneo its thick skin is employed by the natives in the manufacture of various articles of warlike equipment.

292. Intermediate between the Tapir and the Hog, is a very interesting genus, now extinct, but once abundant in Europe; this was termed by Cuvier the *Palæotherium* (ancient wild-beast). Its remains are very abundant in the gypsum quarries near Paris, as well as in other parts of the Continent, and in this country; and ten or eleven species have been recognised, varying in size from that of the Rhinoceros to that of the Hog. The reconstruction (so to speak) of these animals, from the fossil remains which have been so long imbedded in the earth, was one of the first fruits of the accurate study of Comparative Anatomy, prosecuted by Cuvier; whose name has been rendered immortal by the discovery of that intimate connexion existing between the different parts of the same animal, which renders it possible to predict the form of the whole, with almost positive certainty, from the examination of a small part only. The following is his own account of this discovery, to which he was led by the study of a collection of bones dug up from the neighbourhood of Paris. "I found myself, as if placed in a charnel-house, surrounded by mutilated fragments of many hundred skeletons of more than twenty kinds of animals piled confusedly around me; the task assigned to me was to restore them all to their original position. At the voice of Comparative Anatomy, every bone and fragment of bone resumed its place. I cannot find words to express the pleasure I experienced in

seeing, when I discovered one character, how all the consequences which I predicted from it were successively confirmed. The feet accorded with the characters announced by the teeth; the teeth were in harmony with those previously indicated by the feet. The bones of the legs and thighs, and every connecting portion of the extremities, were found to be joined together, precisely as I had arranged them before my conjectures were verified by the discovery of the parts entire. Each species was, in fact, reconstructed from a single unit of its component elements." The deposits in which the remains of the Palæotherium are found, are evidently of considerably older date than those in which the bones and teeth of the Elephants and Mastodons are buried; and the other fossil remains of terrestrial animals, that are found with them, are for the most part very dissimilar to those which now inhabit our globe. These deposits, however, were formed by the agency of fresh water; and there can be little doubt that the bones of Palæotheria which they contain, are the relics of animals which, like the Tapir and Rhinoceros of the present day, frequented the borders of lakes and large rivers, by whose waters they were occasionally ingulphed in seasons of flood.—Another fossil genus allied to the Tapirs is that of *Lophiodon*, which differs from Palæotherium in having only six molars on either side of each jaw, but in other respects closely resembles it. No less than fifteen species of this genus have been distinguished; their remains are commonly found associated with those of the Palæotherium.

293. Returning to the animals now inhabiting our globe, we have next to notice the *Rhinoceros*, a large and ungainly-looking animal, which forms the type of the family RHINOCERIDÆ. This genus (which contains seven living species, as well as several extinct ones, whose remains occur in the same strata with those of the Elephant) is characterised by the possession of three toes on each foot, and by the presence (in most of the species at least) of seven molars on each side above and below, with only four incisors, and no canine teeth. Its most distinguishing mark, however, is the possession of a solid horn, which is supported upon a very strong arch, formed by the nasal bones. The horn

is curved and pointed, and arises from a limpet-shaped base; and it is composed of agglutinated fibres analogous to those of hair, and closely resembling those into which whalebone is so easily separable. In some species, there are two horns, both on the central line of the body; and the hinder one is situated on the frontal bone. The arch on which the horns rest has need of great strength, not only to sustain its weight, but also to resist the

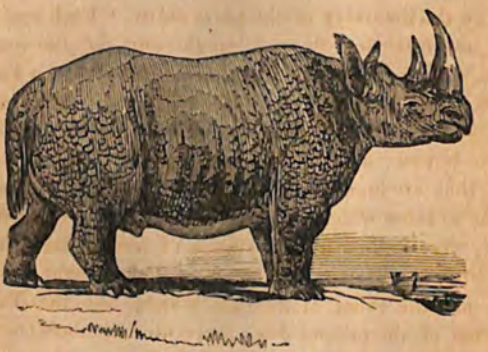


Fig. 164.—Two-horned Rhinoceros.

shock occasioned by the violent blows, which the animal gives with this powerful weapon. The skin of the Rhinoceros is thick and coarse, with a knotty surface; and is destitute, or nearly so, of hairs; in the common Indian species, it is disposed in large folds, especially on the neck, shoulders, haunches, and thighs. The upper lip is prolonged, and in some species is as prehensile as that of the Tapir. The best known species of Rhinoceros is the one which inhabits India; where it leads a tranquil indolent life, wallowing on the marshy borders of lakes and rivers, and occasionally bathing itself in their waters. Its movements are usually slow; and it carries its head low, like the Hog, ploughing up the ground with its horn, and making its way by sheer force through the jungle. Owing to the keenness of its smell and hearing, the Rhinoceros cannot be easily attacked; for on any alarm, it retreats to its covert in the almost impene-

trable jungle; but when brought to bay, it charges with great fury and impetuosity, and tramples down, or rips up with its horn, any animal that opposes it. Even the Elephant cannot withstand its fury. Another species, less powerful and savage, is found in Java; and a third, which possesses two horns, in Sumatra. Four species, each possessing two horns, are found in Africa, of which the best known,—the black, or common Rhinoceros,—is represented in (Fig. 164).—The Rhinoceros appears to have been formerly as widely distributed as the Elephant and Mammoth; and its remains are found associated with theirs. Several species, differing from those at present existing, have been distinctly made out; and of one of these, an entire frozen carcase has been discovered, in the banks of one of the tributaries of the Lena. It had two horns, but differed in many respects from any two-horned species of the present day; and its skin, like that of the Mammoth, was covered with long stiff hair. Remains of the Rhinoceros are found in almost every bone-cavern in England, France, and Germany; and it appears from the researches of Dr. Buckland, that, during a long succession of years, the Elephant, Hippopotamus, Rhinoceros, and Hyæna, were formerly inhabitants of our island,—the last-mentioned of these devouring the others, or preying upon their carcases after natural or accidental death.

294. There is a curious genus of small animals, inhabiting the rocky districts of Africa and Syria, which is intermediate in its characters between the Tapir and Rhinoceros, but presents several points of resemblance to the Rodentia. This is the *Daman*, or *Hyrax*, an active fur-covered little animal, sometimes called the Rock-Rabbit, and probably the *Cony* referred to in the Book of Proverbs. Its skeleton closely resembles that of a Rhinoceros in miniature, and its molar teeth are formed in the same manner; the fore-feet have four toes, which are tipped with hoof-like nails; whilst the hind-feet have three, of which the innermost is furnished with a long claw-like nail. The best known species are the Cape Hyrax, which inhabits Southern Africa; and the Syrian Hyrax of Syria, Arabia, and Abyssinia. Both these are active, wary animals, somewhat larger than Rabbits,

living in families, and taking up their abode in caves or crevices in the sides of rocks; they live upon the young shoots of shrubs, and upon herbs and grass. Two other African species are described as taking up their residence in trees.

295. The family HIPPOPOTAMIDÆ includes only the *Hippopotamus* or River Horse; an inhabitant of the African rivers, which seems to connect the Hog with the Elephant on the one hand, and with the aquatic tribe of Pachyderms (§ 304) on the other. Its body is scarcely inferior to that of the Elephant in bulk; but its limbs are so short that its belly almost touches the ground. In its general aspect it might be compared to a gigantic Pig, but for its short, thick, and very blunt muzzle. The incisors and canines of the lower jaw are long and curved forwards; but the lips are so large, as usually to conceal them. The canines of the two jaws rub against each other, as in the Rodentia, and are continually growing at the base, from a persistent pulp. The stomach is partially divided into several sacs. The feet possess four toes, terminated in separate hoofs. The nostrils open on the top of the muzzle, and the eyes, which are very small, are situated high in the head; hence the animal, whilst its body is submerged in the water, can look around and breathe, by raising but a very small portion of the head above the surface. As its name imports, it passes a large part of its time in the water; usually quitting it by night in search of its food, which consists of the herbage that grows near the banks of the rivers and lakes. It is not confined to rivers, however; for it also tenants the lakes, and seems equally disposed to take up its abode keeping however near the shore. It commonly places where it can walk along the bottom, cover

FIG. 166.—HIPPOPOTAMUS.

feet of water; and comes every five or six minutes to the surface to breathe. It is gregarious in its habits; and sagacious and wary in its disposition. It seems quite inoffensive when left to itself, but shows great fury when attacked; and will sometimes become the assailant upon a very slight accidental provocation. It is believed that two species of this animal exist; though the differences between them have not been satisfactorily ascertained. Their range was formerly much greater than at present; for they gradually retreat as Man advances; but they are very troublesome on the borders of some of the colonies, destroying whole plantations to satisfy the wants of their enormous fabrics. They are in their turn objects of pursuit, on account of their flesh and hide; the former is much in request, and the layer of fat which lies beneath the skin is considered a peculiar delicacy; the hide is of enormous thickness, being two inches deep or more on the back and sides, and is made into shields, whips, walking-sticks, &c. Remains of four species of Hippopotamus have been found in a fossil state in Europe, associated with those of the Elephant and Rhinoceros; indicating that this unwieldy monster must have been once an inhabitant of our rivers.

296. The family SUIDÆ, or *Pig* tribe, forming the section *Zygodactyla*, is the only group of Pachydermata which is widely distributed; its members are found native in the four quarters of the globe. The animals composing it are distinguished by the conformation of their feet, which have four toes enclosed in separate hoofs, the two central toes being much the largest, and divided by a deep cleft. In the common *Hog*, each toe has its own distinct metacarpal or metatarsal bones; but in the *Peccaries*, the metacarpal or metatarsal bones of the two middle toes are consolidated into a single *canon*-bone, which resembles that of the [illegible]minants (§ 254); and the stomach of these animals is parti-[illegible]vided into distinct sacculi, thus presenting another link of [illegible] between the two groups. The molar teeth in this [illegible] in number from three to seven on either side in each [illegible] usually tubercular; the canines are usually very [illegible]ct forwards as tusks, which are used by the animal

as weapons of defence, and for rooting up the ground. The Boar or Wild Hog, which is distributed through the forests of Europe, Asia, and Africa, the Phacochœre, or Vlacke Vark of the Cape Colonists, the Babyroussa of the Indian Archipelago, and the Peccaries of South America, closely agree in their general habits and dispositions. Their food is naturally vegetable, and consists of the stems and roots of plants, together with acorns, beech-mast, and similar materials. They are for the most part inoffensive when not attacked, but display great courage, and even ferocity, when brought to bay; whilst the length of their tusks, and the great strength of the muscles of the neck by which the head is thrown upwards, or violently tossed from side to side, render them very formidable antagonists. When taken young, however, they are easily domesticated, and even become troublesome from their familiarity; but they commonly show a disposition to escape from the control of Man into their native haunts, and to resume their original habits. This disposition is displayed also by the Elephant, the Tapir, and even by the Horse; and it seems to distinguish the Pachydermata from the Ruminants, which, when once brought into subjection to Man, remain peaceably under it.

297. The *Boar* or *Wild Hog* is unquestionably the original stock of our domestic race, and does not differ from the common Pig in any essential peculiarities. The snout, however, is more elongated, the tusks larger (sometimes attaining the length of more than ten inches), and the contour of the frame more gaunt and bony; whilst the muscular strength is much greater, and the temper more savage. Like the domesticated Pig, the Boar is nearly omnivorous; not however attacking and killing other animals for the sake of their flesh, but devouring what may fall in its way. This animal was formerly a native of the forests of Britain, but has been long since extirpated, though at what precise epoch is not known; it still ranges through the forests of France, Germany, and other parts of Europe, and extends also as far as India; there is some doubt, however, whether the European and Indian species are the same. In all ages, the chase of the Boar has been a favourite diversion: it is not unat-

tended with danger, however; for horses and men, as well as dogs, have not unfrequently fallen a sacrifice to the fury of the animal; but this danger perhaps adds to the excitement.—The *Phacochœres* of Abyssinia and Southern Africa closely resemble the Hog in general structure and habits, but differ from them remarkably in their dentition; for the molar teeth are formed very much upon the plan of those of the Elephant, and successively replace one another, by advancing from behind forwards, as in that animal.—The *Peccaries* are the representatives of the Boar in South America; and it is remarkable that, with the Tapirs, they constituted the only representatives of the whole order of Pachydermata, which were found in that continent at the time of its discovery. In ancient times, as we have already seen, numerous species of Mastodons, and other gigantic Pachyderms, roamed over its wilds; but they have gradually become extinct, and have left us only these two comparatively small and feeble genera as their representatives. On the other hand, since the discovery of America by Europeans, many European species have been introduced, which have become naturalised in the country, and now run wild through its plains and forests; this is the case with the Boar, and with the Horse. Independently of the peculiarities already mentioned, the *Peccaries*,—of which there are two species, the *collared*, and the *white-lipped*,—differ from the Hog in possessing only four incisors in each jaw instead of six, and only six molars on each side instead of seven; the canines, too, are not nearly so long, and do not curve outwards. The *Babyroussa* of Java and the Molucca islands is chiefly remarkable for the extraordinary curvature of the tusks of the upper jaw, which is shown in the accompanying figure; the purpose which they serve is entirely

FIG. 265.—BABYROUSSA.

unknown. The incisors are four above and six below; the molars only five on each side.

298. With this family we may also associate a curious fossil genus, the *Anoplotherium* (or beast without weapons), of which remains have been found with those of the Palæotherium. It is remarkable, in the first place, for the arrangement of its teeth, which consist of six incisors, four canines, and fourteen molars in each jaw, forming a continued line,—uninterrupted by that space between the canines and molars which is seen, more or less, in every other animal except Man. The canines were small, resembling incisors in their form, as in the lower jaw of the Ruminants; and the feet had only two toes, sheathed by separate hoofs; but these toes had separate metacarpal and metatarsal bones, as in the Hog, instead of springing from a single canon bone. In these and other points, therefore, the Anoplotherium seems to have been intermediate between the Ruminantia and Pachydermata; its head, judging from the skull, partook of the form of that of the Horse and of the Camel, and did not bear a prolonged snout. Several species have been discovered, varying considerably in their general form; thus, one was heavy in its build, and low on its limbs, and from its flattened tail may be regarded as of aquatic habits; whilst another presented a light, slender, graceful form, with much of the contour of the Gazelle; and was probably a fleet and active inhabitant of the dry land, like the Antelopes and Deer. Others, again, seem to have had the size, form, and habits of the Chevrotains.

FIG. 167. FOOT OF HORSE; *t*, tibia; *ta*, *ta'*, bones of tarsus; *c*, metatarsal, or *canon* bone; *b*, splint-bone; *p*, *pi*, *pt*, phalangeal bones.

299. We next pass on to the group of SOLIDUNGULA, distinguished by the complete consolidation of the toes, so that there is only one set of phalangeal and metacarpal (or metatarsal) bones in each foot; and the extremity is included in a single large hoof. Occasionally, however, the presence of other toes is indicated; for the phalanges and metacarpal bones are sometimes partly, or even completely divided, into two; and the

rudiments of another toe are present on either side as *splint-bones* (§ 254), thus making four in all. This is one of the *monstrosities* or irregular formations, which often enables us to determine the real nature of an organ, when its character has been so changed as to obscure it. The group of single-hoofed Pachyderms contains only one family, the EQUIDÆ, or *Horse* tribe; and the members of this resemble each other so closely, as to render it almost doubtful whether they ought not to be all arranged under the same genus. They all agree in their dentition, possessing six incisors in each jaw, and six molars above and below on either side; the molars have square crowns, with crescentic ridges of enamel. The males have also two small canines in the upper jaw, and sometimes in both; these are wanting in the female. Between the canines and the first molar, there is a wide space, corresponding with the angle of the lips; it is in this that the *bit* is placed, by which alone Man has been able to subdue these powerful quadrupeds.

300. The *Horse* is thought by some to deserve to rank as a *genus* distinct from the Ass, Zebra, &c.; on account of the entire tail being covered with long hair, instead of the tip only; and also because the colour of the hair which clothes the body has a tendency to vary in spots or patches, instead of in stripes. But these are differences which, in other families, would not be thought to separate even *species* very widely. Our ignorance of the original stock of the Horse prevents this question from being positively determined. It was domesticated at a very early period, and was used especially in war and on state occasions. The Egyptians are usually believed to have been its first tamers, on account of the mention made of the Horse, as taken in exchange by Joseph for the corn which he sold*; but as we subsequently read† of Horses as possessed and used in war by the Canaanitish nations, the domestication of the race must have been extensive, even in those remote times. As far back as the records of profane history conduct us, we find the Scythians possessed of Horses, and celebrated as Horsemen; and when Cæsar invaded Britain, he found himself opposed by horsemen

* Genesis, xlvii. 17. † Joshua, xi. 4.

and chariots. Hence we have no power of ascertaining what was the original country of the Horse. The races that are now running wild through the plains of Tartary, are almost certainly descendants of animals that have been in a state of subjugation ; for their habits closely correspond with those of the wild horses which now abound in the Pampas of South America, and which have descended from the domesticated individuals introduced into that continent by the Spaniards, at the time of their invasion of it. They live in troops, which are led by an old male; and when attacked, they put the females and colts in the rear, and make a vigorous resistance by kicking with the hind legs. They are fleet and hardy; but by no means remarkable for beauty. The influence of domestication in modifying the habits of the Horse, is remarkably shown by the fact—which rests on good authority, —that it may be brought to eat meat, though naturally as exclusively herbivorous as any animal; and this diet is said to excite an unusual degree of spirit and mettle, and to enable it better to sustain fatigue.

301. The *Ass* appears to have been domesticated before the Horse ; and it was, as it still is in many parts of the East, the beast usually ridden in civil life ; the Horse being employed almost exclusively for war. When treated with care, attention, and kindness, its appearance and manners are very different from those of the serviceable, but undervalued and neglected beast of our own country. It is in Arabia, Persia, and Syria, that the finest breeds of the Ass are found ; those of Western Europe are quite degenerate. A fine race is bred in Malta. Several species of Wild Ass have been described as natives of Central Asia and Africa ; but there is much uncertainty regarding them ; and it is not known to which the Domesticated stock is to be referred, or whether it is derived from any of them. It seems to differ from them all in the mark which is constantly observed on it,—the cross over its shoulders.—The *Dziggetai* is one of these species, inhabiting the greater part of Central Asia, and distinguished for its fleetness, which equals that of a very swift Arabian ; but it is not easily tamed, being vicious in temper, and kicking violently on the most trifling provocation.—Of the *Zebra*, which is a

native of Southern Africa, two species are known; one of which is an inhabitant of the mountains, and the other of the plains. They are both very handsome and swift-footed animals; but are not easily tamed, their temper resembling that of the last-named species. They live in troops; and, from the boldness of their markings, they present a very brilliant appearance when flying before the hunter.—The *Quagga* is an animal of the same country with the Zebras, and resembles them in habits; but it is far inferior in size and beauty. Its colours are dull, and its stripes less distinct.—The skeletons of all these animals so nearly resemble one another, that they cannot be distinguished by the comparison of a few bones; so that even Cuvier was at fault in determining them. This circumstance prevents any certainty from being attained, as to the relationship between the fossil remains, which have been found abundantly in the newer tertiary strata, and the species now existing. By some it has been supposed that the original stock of our domesticated race is to be traced among these remains. At any rate it is certain, that very numerous animals of the Horse tribe must have formerly peopled Britain, as well as the continent of Europe; roaming over its pastures, and probably climbing its hill-sides, when its forests were tenanted by the gigantic Elephant, its jungles by enormous Tigers, its marshes by the massive Rhinoceros, its caves by the savage Hyæna, and its rivers and lakes by the unwieldy Hippopotamus.

Fig. 163.—Zebra.

502. We have now considered the groups usually arranged under the order Pachydermata; and it might seem that the space between these and the Whale-like animals—destitute of

hind-feet, living entirely in the water, and having the form of the whole body modified for an aquatic residence—is too wide to allow them to be placed in the same order. But here, as elsewhere, the space appears to be filled up by fossil species; the conformation of whose bones affords characters sufficiently decisive, to permit their general structure and habits to be inferred with tolerable certainty, from the consideration of even a small part of the entire skeleton. Before proceeding to these, however, it may be remarked that there is a much nearer connection between the existing species of ordinary Pachyderms and the family of MANATIDÆ, than might be supposed from their form alone. It has been already remarked that, in those species which approach the Ruminants in the division of the feet, there is an approach also in the complexity of the form of the stomach; this is particularly the case in the Hippopotamus; and precisely the same structure is found in the Dugong and Manatee, whose stomachs bear a very close resemblance to that of the Hippopotamus. Both animals are adapted by their conformation and habits, to food of the same description; but whilst the Hippopotamus usually quits the water for its food, and browses upon the herbage and underwood in the neighbourhood, the Manatee is confined to that which grows on the banks of the streams, or beneath the surface. The shortness of the legs, too, in the Hippopotamus, prepares us for the total disappearance of one pair; and the flattening of the tail of the common Anoplotherium shows the tendency to the more full development of that organ in the Manatees. There are other points of resemblance between the Hippopotamus and the Lamantins, in the structure and contour of the skull, in the position of the eyes and nostrils, and in the thick and complete layer of fat beneath the skin; so that the gap is not really so wide as it appears.

303. The remarkable genus which seems to connect the two, has received the name of *Dinotherium*. The skull is the only part yet found; and this presents several extraordinary characters. It is more than a yard long, the nasal portion being so prolonged, as to give the idea that it bore a proboscis; a similar conformation, however, is seen in the Dugong, which is destitute

of that appendage, having only a large upper lip. The upper jaw seems to have been destitute of either incisors or canines; but the lower is armed with two enormous tusks, which, instead of projecting upwards or forwards, sweep downwards and curve gently backwards, having their roots imbedded in enormous sockets. The general conformation of the skull bears so much resemblance to that of the Dugong, as to indicate that the Dinotherium must have been exclusively aquatic in its habits; probably having either the hind-feet formed as paddles, like the Seal; or being entirely destitute of these members. Its diet was undoubtedly vegetable; and we may conceive it to have used its tusks for tearing up strong-fibred plants, by a rake-like action, from the bed of the river, or for anchors by which it might moor itself to the banks, or for hooks by which it might assist itself in dragging its unwieldy body (the length of which was probably not less than eighteen feet) out of the water. Its remains have been found in fresh-water deposits, with those of the Rhinoceros, Tapir, &c.—Another genus, which has been established from the skull only, is the *Toxodon*, of which the only remains at present known are contained in the Museum of the College of Surgeons, London. This was a large South American animal, which seems to have been allied both to the Pachydermata and Rodentia, and to have had the dimensions of the Hippopotamus, though perhaps still more adapted for aquatic habits.

304. Some remains of gigantic Pachyderms, that seem to have been intermediate between the Mastodon and the Dinotherium, have been recently brought from Australia, in some parts of which they are said to abound. "They tell us plainly," says Professor Owen, "that the time was, when Australia's arid plains were trodden by the hoofs of heavy Pachyderms; but could the land have then been, as now, parched by long-continued droughts, with dry river-courses, containing here and there a pond of water? All the facts and analogies which throw light on the habits of the extinct Mastodons and Dinotheres, indicate these creatures to have been frequenters of marshes, swamps, or lakes. Other relations of land and sea than now characterise the southern hemisphere, a different condition of the surface of the

land and of the meteoric influences governing the proportion and distribution of fresh water on that surface, may therefore be conjectured to have prevailed, when huge Mastodontoid Pachyderms constituted part of the quadruped population of Australia; and a change from a humid climate to the present particularly dry one, may have been the cause, or chief cause, of the extinction of the race."

305. The family MANATIDÆ or *Dugong* tribe, has been usually associated, as already stated more than once, with the order Cetacea; but the animals composing it differ almost as much from the true Whales, as a herbivorous from a carnivorous Quadruped. In their fishlike form, the absence of hinder limbs and pelvis, the conversion of the anterior extremities into paddles, the prolonged and horizontally-flattened tail, the nakedness and oiliness of the skin, and other points of adaptation to the life and habits of a Fish, the two groups agree (Fig. 59); and it is interesting to observe, how completely the same objects are attained by similar means, in both cases. But the food of the Dugong and its allies entirely differs from that of the Whales; and all the parts of the structure, immediately concerned in the reception and application of it, vary in a corresponding manner. The molar teeth are formed upon the same plan with those of the aquatic Pachyderms, and are obviously adapted to reduce the submarine vegetables, which are hooked up by means of the tusk-like incisors. The curious provision which the true Whales possess, for causing a large quantity of water to pass through their mouths, that they may strain out, as it were, the small animals it contains (§ 209), is here altogether wanting. And the stomach, instead of being simple in structure, and of moderate size, is large and divided into sacs. Only a few species of this family are known.—The *Dugong*, or *Halicore*, is a native of the Indian Seas, being common among the islands of the Indian Archipelago, and visiting also the coasts of New Holland. It especially frequents the mouths of rivers and shallow waters; and it is pursued on account of its flesh, which is tender and not unlike beef. Its length is eighteen or twenty feet. Another species inhabits the Red Sea.—The *Manâtee*, or *Lamantin*, inhabits the

mouths of the rivers opening on the north and north-east of South America, and the coast of Mexico; it measures six or seven feet in length; and its paddles exhibit rudiments of nails, by the aid of which the animal sometimes drags its unwieldy body on shore, and crawls up the banks, either to bask in the sun, or to seek for terrestrial vegetables. Another species is found on the western coast of Africa; and a third along the shores of some parts of North America.—A remarkable animal, the *Rhytina Stelleri*, belonging to this group, was discovered in 1741 upon the shores of an island in Behring's Straits, where it furnished the principal support of Behring's shipwrecked party for about two months. Within twenty-seven years after its discovery, this curious animal was extirpated by the crews of ships which visited its residence in search of the Sea Otters, and the only remains of it consist of a skull and a few other fragments in the Russian Museums.

Sub-Class II.—OVO-VIVIPAROUS MAMMALIA.

306. The general character by which the animals of this division are distinguished from the true Mammalia have been already explained (§ 118); and it has been shown that these are of sufficient importance, to require that the several species which agree in it, should be associated together in a separate group; even although they differ considerably from one another, in the nature of their food, and in the conformation of those organs by which it is obtained and digested. Thus we find, in some members of this sub-class, an opposable thumb, as perfect as that of many Quadrumana; in others, a set of teeth and sharp claws, obviously adapted to a Carnivorous regimen; in others, again, the general organisation of the Insectivora; in others, an approach to the peculiar conformation of the Rodentia; and in others, the complete absence of teeth, which characterises the true Edentata. Hence some Naturalists have been disposed to arrange these several animals under the Orders, to which they would be referred by the characters just adverted to; forgetting that they are distinguished from these by characters of far higher importance, —those relating to the structure of the brain; which correspond,

on one hand, with the degree of intelligence manifested by the animal; and, on the other, with the manner in which the process of reproduction is carried on in them. For in the brain of Birds, whose early development receives little assistance from the parent, the great central *commissures* (ANIM. PHYSIOL., § 434) are altogether wanting; whilst in the true Mammalia, in which the embryo is sustained by a direct connection with the parent, until it has nearly acquired the perfect form, the two hemispheres of the brain are united by transverse bands, which increase in number and complexity as we ascend towards Man; and in the Ovo-viviparous Mammalia, of which the embryo is born prematurely (as it were), the brain attains a character but very little higher than that of Birds, and the intelligence is proportionably low. When it is recollected that *intelligence*, depending on the high development of the cerebral mass, is the characteristic feature of the class Mammalia, it becomes evident that the group of animals, which differs from the rest in a peculiarity so essential, should be completely separated from them. And it is the less surprising that they should differ among themselves in characters which are elsewhere deemed important, since we find the same occurring in other instances; the lower or least organised portion of a group often presenting sketches, as it were, of the very dissimilar forms, which occur in the several divisions above it. Thus in the Radiata, we may trace *adumbrations* or shadowings-forth of the Molluscous, the Articulated, and even the Vertebrated types; and its several members differ far more among each other in form and structure, than do the members of either of the higher divisions of the Animal kingdom.

307. By some of those who have recently attended to the classification of this group, it is regarded as containing but a single order, and is divided at once into families; but in general it is first subdivided into two orders, which will be here adopted. The first of these contains the MARSUPIALIA or *pouched* animals, so named on account of the peculiar pouch or pocket which most of them possess at the lower part of the abdomen, for receiving and protecting the young during the period of suckling. This pouch is supported by two bones, termed the

marsupial bones, the form and position of which have been already described (§ 90). This order comprehends the *Kangaroos*, *Opossums*, and other less known animals. The second order, —termed MONOTREMATA, and including only two animals at present known to exist, the *Ornithorhyncus*, and the *Echidna*,— receives its name from a peculiarity in the structure of the reproductive apparatus, which shows its near approach to the class of Birds; for the termination of the oviducts is received, with that of the urinary duct, and of the intestine, into a canal termed the cloaca; so that there is but a single external orifice for them all, instead of two, as in all higher animals. There are many other points of structure, in which this remarkable group approximates to Oviparous animals; some of which will be hereafter mentioned.

308. The geographical distribution of this Sub-Class is not one of the least curious parts of its history. With the exception of the *Opossum* family, which inhabits America (and was the first with which naturalists became acquainted), the group is confined to Australia, and the nearest islands of the Indian Archipelago, where upwards of 70 species have been found; more probably remaining to be discovered. And with the exception of the Dingo Dog, a few Bats and Seals, and one or two Rats, these are the only Mammalia known to exist on the vast Continent of New Holland; a circumstance which is without its parallel in the distribution of the Animal Kingdom.

ORDER XI.—MARSUPIALIA.

309. From what has been just stated, of the varieties of conformation which are found in this group, it will be evidently necessary to proceed at once to the description of the families into which it is subdivided; as no account can be given of their general structure and habits, which shall be applicable to more than a small section of the order. The first family, DIDELPHIDÆ, or *Opossum* tribe, is restricted to America, and chiefly consists of

the genus *Didelphis*, or Opossum, of which about twenty species are known, some of them very small. The teeth are more numerous than in any other known terrestrial Mammal except the *Myrmecobius*,*—the increase being in the number of the incisors, which are ten above and eight below, the canines being (as usual) one on each side of either jaw, and the molars seven,—the four last, or true molars, being crowned with sharp tubercles. The limbs are short; the feet plantigrade (or having the sole applied to the ground); and the toes, which are five on each foot, armed with sharp, strong, curved claws, except the inner toe or thumb

Fig. 169.—Virginian Opossum.

on the hinder feet, which is opposable and destitute of a nail. The tail is scaly and naked, except at its base; and is usually more or less prehensile. In some species the pouch is almost

* A small shrew-like Marsupial, whose place seems to be between the two succeeding families. It collects its insect food by protruding a long tongue, in the same way as the Ant-eater.

entirely wanting, being indicated only by a slight fold of skin. The Virginian Opossum, which is common in many parts of the southern states of North America, is one of the largest and most robust of the genus, being about the size of a Cat. It resides in branches and hollows of trees, remaining inert during the day, but prowling at night in search of its food, which consists of insects, eggs, birds, and small reptiles and mammalia, as also of fruits and roots;—sometimes even invading the precincts of farm-houses, destroying poultry, and other domestic birds. Its movements on the ground are slow; but it climbs with great facility, and can suspend itself from branches with its tail, sometimes gaining distant branches by a kind of swinging motion. When alarmed or irritated, it emits a most disgusting odour. In captivity it is slothful, and becomes inordinately fat, eating both animal and vegetable food with voracity; it shows but little intelligence, and evinces great apathy with some timidity. The female produces several young at a time, sometimes as many as sixteen; and she conceals herself in a thick nest of dry grass, in some obscure retreat. When first born, the young are in a very undeveloped state, being minute, blind, naked, and shapeless; but they are always found adhering to the teats of the mother, protected by her pouch. There they remain until they have attained the size of a mouse, which is not until the fiftieth day; at this period their eyes are opened, and their bodies are covered with hair. They now venture occasionally from their hiding-place, but return to it on the least appearance of danger; and it is not until they have attained to a considerable size, that they finally withdraw from the care of the parent. Even when they no longer resort to her pouch for protection, it is said that they jump on her back, and twine their tails securely with hers; so that she may carry them off from the threatened danger.—The *Crab-eating Opossum* is common in Guiana and Brazil; it climbs trees with facility, but runs badly; and prefers marshy situations, where it feeds upon crabs, but also attacks small birds and reptiles, and will eat insects.—Several of the South American species are very small, and are quite insectivorous in their habits, so much resembling the Shrews in size and general appearance, as

to have been mistaken for them: others are about the size, and have the appearance and habits, of the Rat.—The only other genus

Fig. 170.—Crab-eating Opossum.

included in the family of Didelphidæ, is the *Cheironectes*, or *Yapock*, an inhabitant of the smaller streams and rivers of Brazil and Guiana. This interesting animal bears a strong general resemblance to the Otter, but is much smaller. It is incapable of climbing, but lives in holes along the banks of the rivers it frequents; and it is provided with cheek-pouches, in which it stows away the food it obtains in the stream, consisting of fresh-water Crustacea, the larvæ of insects, the spawn of fishes, &c. In this genus we do not find an opposable thumb on either foot; and the toes of the hind-feet are webbed. It differs from the Opossums also, in

the number of molars, which are only five on each side of either jaw.

FIG. 171.—CHEIRONECTUS

310. If we regard the Opossums as representing the Quadrumana among the Ovo-viviparous Mammalia, we shall find still more analogy between the next family, DASYURIDÆ, or *Ursine Opossums*, and the Carnivora: this analogy is shown in the structure of the teeth and digestive organs, and also in the habits of the animals themselves, as is sufficiently indicated by the names, *hyæna*, *wild-cat*, *bear*, *devil*, &c., which are given to the several species by the colonists of Australia, where alone they occur. As an example of this family, we may notice the *Dasyurus ursinus*, or Ursine (bear-like) Dasyurus, a native of Van Diemen's land, not unlike the Badger in shape, and having the gait of a Bear. It is a stupid, voracious animal, which conceals itself in burrows or holes in the ground during the day; issuing forth at night in search of its food, which appears to be entirely of an animal nature. The flocks and domestic poultry of the colonists suffer considerably from its ravages. The teeth resemble those of the Opossum in their general aspect; but differ in having only eight incisors in the upper jaw and six in the lower; and also in the number of the molars, which are six instead of seven.

Their form, too, is more decidedly carnivorous; the individual teeth being by no means unlike those of the Dog. The limbs are short, robust, and clumsy; and the toes, five on the fore-feet, and four on the hind, are armed with sharp claws, which the animal can use for burrowing, as well as for seizing its prey. Its voice is a hollow barking growl. When in captivity, it displays no quality but a stupid ferocity, and seems ready to bite at the least irritation; it does not appear in the least influenced by kind treatment, not even showing any recognition of its keepers, or of those who habitually feed it.—In other species of this genus, there is a stronger resemblance to the Dog and Weasel, and greater activity in the habits.—The *Thylacinus*, also a native of Van Diemen's Land, has the stature and habits of a Wolf; and would prove a very destructive animal, if it were not for its rarity. It inhabits the caverns and fissures of the rocks, in the deep and almost impenetrable glens of the highest mountains; and, like many others of this group, it is nocturnal in its habits. It seems to have the power of over-mastering all the native quadrupeds of Australia, managing to eat even the Echidna or porcupine ant-eater; and it is very destructive to the sheep in its neighbourhood. Owing to its back being crossed by a regular series of black stripes, it has received from the Colonists the names of Zebra-Wolf and Zebra-Opossum; and has also been called the Tiger and Hyæna.

311. The animals of the next family, PERAMELIDÆ, or the *Bandicoot* tribe, are evidently analogous to the Insectivora, and take the place in Australia of the Shrews, Tenrecs, &c. of the Old World. In number of teeth, they approach the Opossums, but have only six instead of eight incisors in the lower jaw; the form of the teeth, however, is more decidedly insectivorous. The general form of the Bandicoots is Rabbit-like, the hind legs being much longer than the fore, and the gait being intermediate between running and jumping; moreover they resemble Rabbits in the use they make of their fore-paws in burrowing, and in holding their food, when they sit upon their haunches. The form of the muzzle, however, is different; for this is elongated, narrow, and pointed, the nose advancing

considerably beyond the jaw. Notwithstanding the insectivorous form of the teeth, it appears from the accounts of the colonists, that these animals feed in great part upon roots, and that they are very destructive to the potato-crops, as also to the corn when housed in granaries. It is probable that there may be a difference in this respect among the several species, which are numerous, one of them inhabiting New Guinea.

312. The family MACROPODIDÆ (long-footed), or *Kangaroo* tribe, receives its name from the enormous length of the foot, which is the distinguishing characteristic of the posterior extremity, in all the animals it includes. The anterior members are small and comparatively feeble; but the posterior, together with the tail, attain a degree of development, to which we do not see an approach in any other animal, except in the Jerboa and some others of the Rodentia. In their ordinary position, these animals sit nearly erect upon their haunches, the head and shoulders being elevated and slightly inclined forwards; and the weight of the body is counterpoised by that of the tail, which is of enormous size, and serves at the same time to balance and support it. The form and arrangement of the teeth, and the conformation of the stomach, remind us of the order Ruminantia; to which this family, being exclusively herbivorous in its diet, bears no inconsiderable analogy. The canines are usually wanting, and there are only two incisors in the lower jaw, whilst there are six in the upper; the molars are five on each side, and have a roughened surface, which is given by a vertical plate of enamel surrounding a centre of bone. The stomach is very large, and is divided into distinct sacculi; and the Kangaroo appears occasionally (though not regularly) to perform a true rumination, which it does in the erect attitude. When feeding, it assumes a crouching position, resting

FIG. 172.—KANGAROO.

on its fore-paws, as well as on the hinder extremities, whilst it browses on the herbage; and in this attitude it hops gently along, deriving some assistance from its tail. On the least alarm, however, it raises itself on its hind legs, and bounds away to a distance with great rapidity. The leap is of very great length; and is accomplished by the muscular action of the tail, almost as much as by that of the limbs (ANIM. PHYSIOL., § 661). Sometimes the old male of the Great Kangaroo,

FIG. 173.—SKELETON OF KANGAROO.

when excited, stands on tiptoe, and on his tail, the three extremities forming a tripod; and is then of prodigious height. The great length of the hind foot is chiefly given by the elongation of its metatarsal bones; it possesses four toes, of which the two inner ones are very small, and compacted together so as to appear like one; the third or middle toe is large and powerful, and armed with a strong hoof-like nail; the fourth or external toe is smaller than the middle one, but is larger than the two inner ones together, and it also has a large hoof-like nail. These defences make the foot a very powerful weapon; a single blow from it being often sufficient to kill a dog. The under side of the foot has a callous sole along its whole length. The fore-paws have five toes armed with sharp claws; they enjoy considerable freedom of motion, the clavicles being well developed; and they are used by the animal for a great variety of purposes. They even aid the Kangaroo in its defence; for it will sometimes

clasp them around its antagonist, and hug it to death, or hold it beneath the surface of the nearest water until it is drowned.

313. A considerable number of species of this group have been discovered in New Holland, Van Diemen's Land, and New Guinea. They are very similar in form and habits. The largest is the *Great Kangaroo*, which is very extensively diffused through the two former countries, preferring the low grassy hills and plains skirted by thin open forests of brushwood, to which it resorts for shelter from the oppressive heat of the mid-day sun; but it is also found [redacted] the bleak and even snow-capped summits of mountains. [redacted]ale, w[redacted] greatly exceeds the female in size, has been known t[redacted] nearly eight feet from the nose to the extremity of [redacted]e length of the latter being three feet); and to w[redacted] lbs. The other species, however, are much smaller. T[redacted]oung are produced in an extremely imperfect state. One [redacted]hich was examined twelve hours after birth, is thus described by Mr. Owen. "It resembled an earth-worm in the colour and semi-transparency of its integument, adhered firmly to the point of the nipple, breathed strongly, but slowly, and moved its fore-legs when disturbed. Its body was bent upon the abdomen, its short tail tucked in between the hind-legs, which were one-third shorter than the fore-legs. The whole length from the nose to the end of the tail when stretched out, did not exceed one inch and two lines." In this condition it is not able to suck the milk from the teat of its parent; but the mammary gland of the Kangaroo is acted on by a peculiar muscle, which presses the fluid from it into the mouth of the young animal. The embryo (for such it must be still considered) continues to increase by sustenance derived exclusively from the mother, for a period of eight months; but it then begins to protrude its head occasionally from the orifice of the pouch, and to crop the grass at the same time that the mother is browsing. Having thus acquired additional strength, it quits the pouch, and hops at first with a feeble and vacillating gait; but it continues to return to the pouch for occasional shelter and supplies of food, until it has attained the weight of 10 lbs.—The *Tree Kangaroos* (*Dendrolagus*) are arboreal in their habits.—

There is another genus belonging to this family, that of *Hypsiprymnus*, including the *Potoroos*, or *Kangaroo-Rats*, of which several species are known in Australia. They chiefly differ from the Kangaroos, in possessing canine teeth in the upper jaw; but in other respects bear a close resemblance to them. They present, however, a nearer approach to the Rodentia, both in their dentition and habits; for the foremost pair of incisors in the upper jaw are larger and considerably longer than the rest, and meet the large incisors of the lower jaw; whilst with their long and powerful fore-claws, they are continually scratching the ground for roots, feeding rather upon these than upon herbage. They are all of small size; the largest having the dimensions of a Rabbit.

314. The family PHALANGISTIDÆ, or *Phalangers*, are nearly allied to the Kangaroos in the conformation of the head and teeth; but they more resemble the Opossums in general structure and habits, and may be considered as representing those animals in Australia and the islands of the Indian Archipelago, in which they are found. They are nocturnal in their habits, and live among trees, being expert climbers. Their food consists principally of fruits, buds, leaves, &c.; but they will also eat insects and eggs, and even cooked meat when offered them. They agree with the Opossums, also, in having a large opposable thumb on the hind-feet; but they have only six incisors in the upper jaw, with two in the lower, as in the Kangaroo; canines in the upper jaw only, as in the Kangaroo-rat; and five regular molars, with small additional ones between these and the canine teeth in some species. The tail is prehensile, and the Phalangers will sometimes remain suspended by it for a considerable time; and, like the Opossums, they emit a very disagreeable odour when alarmed. They are covered with a very soft and delicate woolly fur. A considerable number of species are known, the largest of which is of about the size of a Wild Cat.—Besides the true *Phalangistæ* or *Phalangers*, this family includes the *Petaurus* or *Flying Phalanger;* an animal which bears the same relationship to the true Phalanger, as the Flying Squirrel does to the ordinary Squirrel. The skin of the

body is extended between the anterior and posterior limbs on each side, for some distance beyond the flanks; and serves as a parachute, by which the animal can partially sustain itself when taking leaps of great length. Its aerial evolutions, when roused to activity by the shades of evening, are said to be peculiarly graceful. It seems to have the power of altering the course of its movements, while suspended in the air, so as to alight on the desired spot. It is destitute of the prehensile tail of the true Phalangers; and seems to be endowed with these wing-like appendages, by way of compensation.—The *Phascolarctos* or *Koala* is a third form belonging to this family. It is a stoutly-made animal, with robust limbs and powerful claws, but entirely destitute of tail. The fore-feet have each five toes, of which *two* are opposed to the other three,—a solitary instance among Mammalia; but in the hind-feet this power does not exist, although the thumb is separated from the rest. This animal lives chiefly among trees, and feeds upon fruits; and in passing along the branches, it suspends itself by its claws, beneath their lower side, in the manner of a Sloth. It also visits the ground, however, and there burrows with facility; and it is said to lie dormant beneath it during the cold season. The young one, when it leaves the pouch, clings to the back of the parent for some time. By the colonists this animal is usually termed the native Bear or Monkey.

Fig. 174.—Phascolarctos or Koala.

315. The last family, that of the Phascolomyidæ, at present contains only a single species, the *Phascolomys* or *Wombat*, which

is evidently a representative of the order Rodentia. The incisors are two in number in each jaw; they are hollow at the base, and continue to grow as they are worn away; as do also the five molar teeth on either side. It is a clumsy-looking animal, having short stout limbs and a blunt muzzle; it burrows deeply in the ground, feeding on roots and hard vegetable substances; and is nocturnal in its habits. Its temper is usually placid, but it will show considerable snappishness when provoked; and its intelligence seems extremely low.

316. Fossil remains of several species of Marsupials have been found in the bone-caves of Australia, in which country their occurrence might be fairly anticipated. But there is evidence that this order was formerly diffused more widely over the globe, than it is at present; for remains of animals which unquestionably belonged to it, have been found in Europe, and even in our own country. Bones of an Opossum were found by Cuvier in the gypsum beds of Montmartre (near Paris); and portions of the lower jaw of two Opossum-like animals have been discovered in the oolite of Stonesfield in Oxfordshire. These last remains have given rise to much discussion; some eminent Anatomists having maintained that they are not the remains of Mammals at all, but of animals of the Reptile class. But the question may now be considered as finally settled; since the examination of the microscopic structure of the teeth has shown, that it corresponds exactly with that of other Marsupials, and differs entirely from that of any Reptiles. It is extremely interesting to remark, that these remains occur in strata much lower (and therefore older) than those in which any other remains of Mammalia are found; whence it may be concluded, that the Ovo-viviparous sub-class was called into existence at an earlier period in the history of the Globe, than that at which the true Mammalia were created.

Order XII.—MONOTREMATA.

317. The peculiar characters by which this order is separated from the preceding, have been already noticed (§ 307); and it now only remains, therefore, to describe the two remarkable animals, which are its sole representatives at present known.—The *Ornithorhyncus* or *Duck-billed Platypus*, the *Water Mole* of the Colonists, is peculiar not only in regard to its internal structure, but as to its external aspect. For having the body of an Otter, its muzzle is not conformed like that of any other Mammal, but is converted into a *bill*, closely resembling that of a duck, being broad, flat, and covered with a leathery membrane. This union appeared so startling to the Naturalists by whom the stuffed specimen of the animal was first inspected, that they imagined that a clever deception must have been practised; the bill of a

Fig. 175.— Ornithorhyncus Paradoxus.

Bird having been artificially attached to the skin of an Otter-like Quadruped. This, however, was soon found not to be the case;

the combination being one effected by the hand of Nature, and serving (with others of a similar character) to draw together the classes of Mammals, Birds, and Reptiles, which previously appeared to be so widely separated. As in Birds, the bill possesses no true teeth; but on each side of either mandible, there are two horny appendages without roots, of which one is large with a rounded summit, whilst the other forms a long narrow ridge near the anterior edge of the mandible. The mouth is furnished with capacious cheek-pouches. The fore-feet possess five toes, furnished with strong blunt burrowing claws; and between these a web extends, even beyond their extremities. This web can be folded back by the animal at pleasure; and it consequently presents no impediment in the act of burrowing. The hind-feet are smaller and less powerful than the anterior; they, too, have five toes, armed with claws, and furnished with a web; but the web does not extend beyond the roots of the claws. The hind-feet are directed backwards, like those of the Seal; and they are obviously used chiefly for swimming. The foot of the male is armed with a sharp spur, resembling that of a Cock. It does not appear, however, to be used by the animal as a weapon of defence. It was formerly supposed (but incorrectly) to secrete a poisonous fluid. A rudiment of it is present in the female. The body of the Ornithorhyncus is long and flattened, and is covered with a very glossy, closely-set fur, resembling that of the Mole; beneath this is a layer of soft, short, waterproof wadding. The tail is strong, broad, flattened, and of moderate length; it is covered above with longer and coarser hairs than those of the body, but its under-surface is nearly naked. The length of the whole animal, from the front edge of its beak to the tip of its tail, is usually from 20 to 23 inches.

318. The whole structure of this singular animal proclaims its aquatic habits; and these are very much what we might expect. It passes a great part of its time in the water, and in the mud of oozy banks; and seeks for the insects, small shell-fish, &c., on which it feeds, by plunging its bill into the mud, exactly in the manner of a Duck. It appears, that, when these are scarce, it will eat water-weeds,— such having been found in

the cheek-pouches. The animals usually remain at the surface of the water, with the head slightly raised above it; but upon the slightest alarm they instantly disappear; and they are so watchful of danger, that the mere act of levelling a gun is sufficient to cause them to dive. After some little time, they reappear at some distance from the spot where they sank. Their burrows are excavated in the banks of the streams they inhabit, and are of very curious construction. The entrance is situated near the water's edge, on a steep part of the bank; and is concealed amongst the herbage. It gradually rises from the level of the stream, proceeding in a serpentine direction to a distance of twenty or even fifty feet from the entrance; and its termination is enlarged, so as to form a kind of nest for the parents and their offspring, which is strewed with dry river-weed. The burrows have usually a second orifice, below the surface of the water; communicating with the passage just within the upper entrance.

319. The young are produced in a very imperfect state, and are very unlike the fully-developed animal. The skin is entirely destitute of fur, and is thrown, by the curling of the body, and the doubling of the head and tail beneath it, into transverse folds; the eyes are not formed, and their place is merely indicated by the presence of a few wrinkles on the skin. The margin of the bill is at that time soft, and the tongue (which in the adult does not extend between the mandibles) advances to its front edge; so that the young animal can obtain nourishment by sucking, which was at first thought impossible. The mammary gland of the female is very simple in structure, and is divided into a large number of separate lobes; this is just what might be expected, when it is remembered that the organ here makes its first appearance, and presents therefore its lowest grade of formation (ANIM. PHYSIOL., § 358). The Ornithorhyncus is *truly* ovo-viviparous; for the embryo appears hardly to derive any other sustenance from its parent, up to the time of its birth, than that which is stored up for it in the ovum; but, as in some Lizards and Fishes, the egg is hatched (as it were) within the oviduct, so that the young is born alive. In consequence of its imperfect condition, however, it cannot leave its burrow or nest

for some time; and this serves for the protection of the young Ornithorhyncus, as the pouch of the Opossum or Kangaroo does to its helpless offspring. A very interesting account has been given by Mr. G. Bennet,* of the habits of some of these animals, which he kept in a state of captivity, during his residence in Australia. The Ornithorhyncus appears from this statement to be a lively interesting creature. Its voice, which it utters when alarmed or disturbed, resembles the growl of a puppy, but in a softer key. It dresses its fur, combing it with its feet, and pecking at it with its beak; and seems to take great delight in keeping it smooth and clean. When asleep, it sometimes rolls itself up like a hedgehog, or curls itself like a dog, keeping its back warm by bringing over it the flattened tail. The young are playful, and gambol with one another in a very animated manner. They appear to be in a great measure nocturnal, preferring the twilight to the glare of day. They may be fed upon bread soaked in water, chopped egg, and meat minced very small. Two species have been described, differing slightly in colour; but it is doubtful whether these are more than varieties. The Ornithorhyncus is confined to New Holland and Van Diemen's Land.

320. The *Echidna*, or *Porcupine Ant-eater*, seems at first sight very different in its conformation from the Ornithorhyncus; but in the most important particulars of its structure it closely resembles it, though differing widely in its habits, and in all the peculiarities connected with them. It is about the size and form of a Hedgehog, which it also resembles in having its body covered with spines; but these are much

Fig. 176.—Echidna.

* Transactions of the Zoological Society, Vol. I.

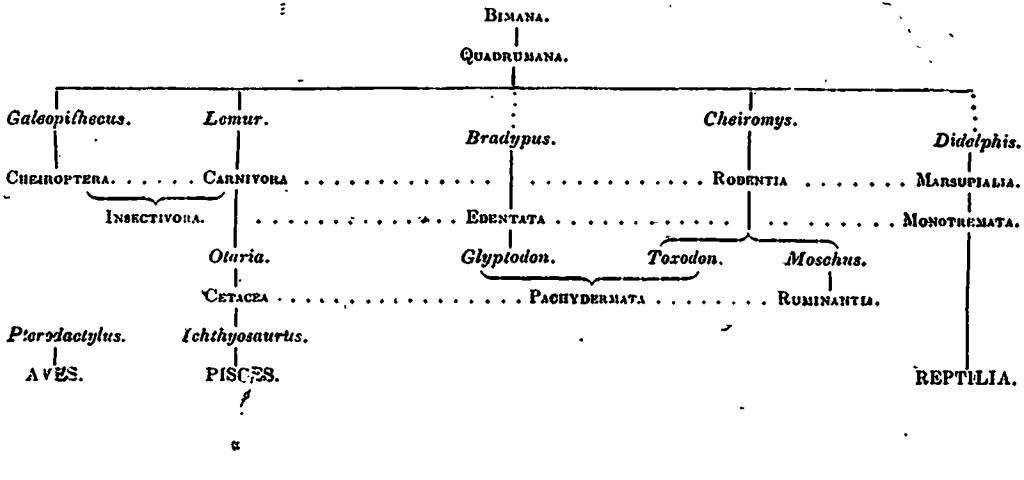
stouter than in that animal; and the two are easily distinguished by the long narrow snout which the Echidna possesses. This snout is formed by the elongation of the muzzle, and is cleft at the point by a very small mouth. The jaws are destitute of teeth, as in the true Ant-eater (§ 250); and the tongue is long and slender, and capable of being protruded to a considerable distance. The legs are short, but large and strong; and both the hind and fore-feet possess five toes, which are armed with strong slightly-curved claws. On the heel of the hind-foot is a curved horny spur, like that of the Ornithorhyncus. The *Echidna* is a burrowing animal; and the broad strong claws of its fore-feet appear to be used for digging out the earth; while the large hollow claws of the hind-feet are to enable the animal to cast away the loose soil. These members are twisted, and directed obliquely backwards, in such a manner that the sides of the claws lie on the ground, and the concave surface or sole of the foot is behind; thus forming very efficient shovels for this purpose. The skin of the Echidna is remarkably thick, to give attachment to the strong spines with which it is covered; and it can erect these in the manner of a Hedgehog, though unable to roll itself into a ball, like that animal. The spines are intermingled with coarse hairs, which also clothe the limbs and under surface of the body. This animal lives entirely upon insects; which it obtains, in the same manner with the Ant-eaters, by entrapping them with the viscous secretion that covers its long tongue. It inhabits the mountain ranges of Australia; and a second very similar species is found in Van Diemen's Land. It burrows with great rapidity; and will even work its way under a pretty strong pavement, or the foundation of a wall, removing the stones with its claws. When attacked by dogs, it quickly sinks itself in the earth or sand, so as to present nothing but its prickly back to its adversaries. In one instance, a large chest of earth containing plants being given to an Echidna in captivity, it made its way to the bottom in less than two minutes. This individual is described as stupid and inert; and for the first month after its capture, it took no food whatever. It became very thin, but did not appear to suffer. It afterwards

ate a mixture of flour, water, and sugar, upon which it lived for some time. It made frequent efforts to get out of its cage, and displayed very great strength. The possessor of another captive Echidna speaks of it as in his opinion the strongest Quadruped, for its size, in existence. To lift it from the ground requires more force than would be supposed; so firmly does it fix itself to the earth, by means of its powerful feet and claws. The animal is now very rare; and but little is known of its habits in a state of nature.

321. The following Table, constructed by Professor Owen,* is designed to express the connexions of the several orders of Mammalia with each other, and the points at which they are most nearly related to the inferior Vertebrata. The names of the orders are printed in small capitals; and those of the connecting genera in italics. Where the union is by a continuous line, it is intended to show that the connexion is very close; but where the line is dotted, or a blank space is left, the links are more or less wanting. Thus the order QUADRUMANA is closely connected with the CHEIROPTERA by the *Galeopithecus* (§ 163); with the CARNIVORA by the *Lemur* (§ 161); with the RODENTIA by the *Cheiromys* (§ 164); with the MARSUPIALIA by the *Didelphis* (§ 309); and less closely with the EDENTATA by the *Bradypus* (§ 240), which approaches the QUADRUMANA in certain particulars. Again, the CARNIVORA and the CHEIROPTERA are connected by the INSECTIVORA; and the former are united to the CETACEA by the genus *Otaria*, or Fur-Seal (§ 202). The EDENTATA are connected with the PACHYDERMATA by the fossil *Glyptodon* (§ 247); and this last order is connected with the RODENTIA by the fossil *Toxodon* (§ 303). With the RODENTIA, again, the RUMINANTIA are connected by the genus *Moschus* (§ 276).

* Cyclopædia of Anatomy, Vol. III. p. 245.

RELATIONS OF THE SEVERAL ORDERS OF THE CLASS MAMMALIA.



CHAPTER IV.

OF THE CLASS OF BIRDS.

322. The class of Birds, which includes all the animals furnished with an internal skeleton and expressly adapted for flight, is one of the most distinct and clearly characterised of all the subdivisions of the Animal kingdom; whether we consider merely the external configuration of these beings, or attend exclusively to the peculiarities of their internal structure, or observe the manner in which their functions are executed. To define this group, it would be sufficient to say, that Birds are *oviparous vertebrated animals, whose circulation is double and complete;* but to give an exact idea of its principal characters, we must add, that the *respiration of birds is atmospheric and double* (that is, instead of being carried on in the lungs alone, as is that of the Mammalia and Reptiles, it takes place both in these organs and in the whole interior of the body), that their *blood is warm* like that of the Mammalia; *that their anterior members have the form of wings;* and *that their skin is covered with feathers.*

323. The conformation of these animals varies but little; and harmonises with the mode of locomotion for which they are peculiarly designed. They seldom attain a large size; and the presence of a considerable quantity of air within their body, renders them very light. The feathers, which cover the whole body of the Birds, are productions very analogous to the hairs of Mammalia; but of a more complicated structure. We may generally distinguish in them a horny tube, which forms the lower part, and which is pierced at its extremity; a stem which surmounts this tube; and *laminæ*, or *vanes*, on each side of the stem, which are themselves furnished with small barbs; and these sometimes appear, in their turn, fringed on their edge. The secreting organ intended to form the feather, is termed the

capsule; and it often acquires a considerable length. From the observations of M. Fred. Cuvier, it would appear, that the capsule grows during the whole period of the development of the feathers; and that in proportion as its base lengthens, its extremity dies,—drying up as soon as it has formed the corresponding portion of this appendix Each capsule is composed of a cylindrical sheath, lined internally with two tunics united by oblique partitions; and of a central bulb.—The substance of the feather is deposited on the surface of the bulb; and, to form the laminæ, it is moulded as it were in the spaces between the partitions. In the portion corresponding to the stem, the bulb is in contact with its lower surface; and after having deposited there a spongy substance, it dries up and dies; but where the trunk of the feather is tubular, the plate of horny matter which the secreting organ deposits, turns round it and completely envelopes it; this bulb, however, when it has fulfilled its functions, dries up, and forms, in so doing, a series of membranous cones, imbedded in one another, which fill the interior of the tube, and are sometimes called the *cores* of the quill.

324. The new feather is at first inclosed in the sheath of its capsule, which often projects several inches beyond the stem, and is gradually destroyed. The feather is then uncovered; and its laminæ, at first rolled together, unfold laterally; the extremity of the tube remains imbedded in the skin, but in general can be easily detached, and falls off at a certain period to give place to a new feather. This removal of the feathers, which is called *moulting*, generally takes place every year after the period of incubation (the laying and hatching the eggs), and sometimes twice in the same year, in spring and in autumn; it is earlier in old individuals than in young ones, and is a period of discomfort to the bird, which loses its voice whilst it is going on.

325. The form of these tegumentary appendages varies much; there are some which are destitute of laminæ, and resemble porcupine's quills; of these there are four or five in the wing of the Cassowary. In others the laminæ are stiff, and provided with small barbs which hook together, so as to form an expanded surface, which offers complete resistance to the air; this is the

case with the wing-feathers of the Eagle and the Crow. There are others, again, in which the vanes and their barbs are long and flexible, and do not hook into each other, so that they have an extreme degree of lightness and softness; feathers of this kind are met with in the wings and tail of the Ostrich. And lastly, there are some which resemble mere *down*, the laminæ being very narrow and totally unconnected; such are those, obtained from the Adjutant, which are much valued as articles of ladies' dress, and are known under the name of *Maraboo* feathers. The colours of feathers are exceedingly varied, and often surpass in beauty and splendour those of the most beautiful flowers, or the most brilliant stones. The plumage of the female is generally less varied than that of the males; and the young birds rarely exhibit the colours that they will preserve all their lives; they often change for two or three years successively; and sometimes the adult has a summer plumage quite different from its winter one. Among aquatic birds the feathers are provided with a fatty matter, which renders them impermeable to water; this enables them to preserve the skin of the animal from contact with the liquid in which it is partly plunged.

326. The *skeleton* which determines the general form of Birds, and which is at the same time one of the most important parts of its apparatus for locomotion, is composed of nearly the same elements as among the Mammalia; but the form and arrangement of many of its bones are different; and with an equal volume they are also lighter, most of them being hollowed out into numerous small cavities filled with air. The head of these animals (Fig. 178) is generally small; when young the skull is composed of the same bones as in the Mammalia; (viz. two frontal bones, two parietal, one occipital, two temporal, one sphenoid, and one ethmoid); but all these parts are firmly fixed together at a very early age; and then cease to be recognizable. The face is almost entirely formed by the jaws, which are much elongated, and which, being destined to constitute the principal organ of prehension, vary much in size and form according to the nature of the objects which the bird will require to seize. The upper mandible is so united to the frontal bone, as to preserve

some power of motion; and the lower, instead of directly articulating with the cranium by a projecting condyle, as in the

FIG. 177.—SKELETON OF VULTURE.

vc, cervical vertebræ; *vs*, sacral vertebræ; *vq*, caudal vertebræ; *cl*, clavicle; *h*, humerus; *o*, bones of forearm; *ca*, carpus; *ph*, phalanges; *st*, sternum; *f*, femur; *t*, tibia; *ta*, tarsus.

Mammalia, is suspended to a moveable bone named the *tympanic bone*, or *os quadratum*, which is analogous to a portion of the temporal bone detached from the main part, to which it is united in the preceding class. Each of the branches of this jaw is composed of two pieces, instead of being formed of a single bone; and it is by that it articulates

FIG. 178.—SKULL OF EAGLE.

a cavity, not by a projecting condyle,

with the tympanic bone. The articulation of the head with the vertebral column permits more varied movement than in the Mammalia; for it is effected by a single condyle, a kind of half-spherical pivot, situated on the central line of the body, below the large occipital foramen, and received into a corresponding cavity in the atlas.

327. The neck of Birds is generally longer and more moveable than that of most Mammalia; as the beak is generally the only organ of prehension by which they pick up their food from the ground, the cervical portion of the vertebral column (Fig. 177) becomes longer, in proportion as these animals are more elevated on their feet; and where they are essentially swimmers, as the Swan, and plunge their head in the water to seize their prey, the length of their neck in many cases much surpasses the height of the trunk. The number of cervical vertebræ varies in different species; generally there are from twelve to fifteen, but in some cases there are not so many, and in others there are more than twenty, as in the Swan for instance. They move easily on one another, and from the nature of their articulating surfaces, the neck can bend in the form of an S, so as to shorten or lengthen, as the curves increase or diminish. This arrangement is particularly remarkable in Waders, such as the Stork; which, to seize their prey, require to dart their beak to a considerable distance with great rapidity. The action of the muscles destined to move this part, is also facilitated by the existence of numerous processes, serving for their insertion. The vertebræ of the back, on the contrary, are in nearly all Birds, almost immovable; and we readily perceive the importance of this arrangement in animals destined for flight; for this portion of the spinal column, serving to support the ribs, and consequently furnishing a point of attachment to the wings, requires great solidity. In general these vertebræ are even united to each other; but in Birds which do not fly, such as the Cassowary and the Ostrich, they preserve some power of motion. The lumbar and sacral vertebræ are all united in a single bone, which has the same use as the sacrum in Man. The coccygeal vertebræ are small and moveable; the last, which supports the large feathers of the tail, is

generally larger than the others, and elevated into a projecting crest.

328. The ribs of Birds also present some peculiarities of structure, which tend to give solidity to the thorax. The cartilage, which in the Mammalia fixes them to the sternum, is here replaced by a bone; and each of them is provided in the middle with a flattened process, which is directed obliquely backwards above the next rib; so that all these bones have points of support on one another. But the most remarkable part of the osseous structure is the sternum; which, as it gives insertion to the muscles of flight, presents in Birds a very high development, and constitutes a sort of convex buckler, usually square, which covers the thorax and a large part of the abdomen.

Fig. 179.—Skeleton of Ostrich.

In the Cassowary and Ostrich, which cannot rise in the air, and which have only rudimentary wings, the sternum does not present

any ridge on its front surface; but in other Birds there is a kind of projecting and longitudinal keel, (*b*, Fig. 180), which gives more power to the muscles which draw down the wing.

329. The shoulder bones also are so disposed as to give the greatest power to the wings. The *scapula* (*o*, Fig. 180), is narrow, but much lengthened in the direction parallel to the spine; and is supported on the sternum not only by the *clavicle* (*f*), but also by another bone (*c*) which fills the office of a second clavicle, and which is called the *coracoid* bone, from its apparent analogy to the coracoid process of the human scapula. The clavicles of the two sides are generally united at their anterior extremity in the form of a V, whose point is directed downwards, and are attached to the keel of the sternum; this compound bone is termed the *furcula*, and in common language the merry-thought. The coracoid bones constitute the buttresses, which, with the furcula, keep the shoulders separated, and afford to the humerus a point of support, so much the firmer as the Bird is a better flyer. In Birds which fly but little, or not at all, the clavicles have, on the contrary, but a slight development. Thus in certain terrestrial Parroquets of Australia, these bones are completely rudimentary; in the Cassowary and American Ostrich they are represented only by slender, pointed processes; in the African Ostrich and the Toucans, they almost reach the sternum, but are not united together at their lower extremities; among some Owls they are united by a cartilage; whilst in most Birds their union is complete, and they are often directly supported on the sternum, by means of a central projection from the point of union.

FIG. 180.—BONES OF THE SHOULDER AND STERNUM.

330. The anterior members of Birds never serve either for walking, prehension, or touch; but form lateral expansions

named *wings*. When speaking of Bats, we saw an example of the transformation of the thoracic member into an organ of locomotion in the air; in those animals it is a fold of skin which serves to strike the air, and the fingers are much prolonged for its support;—but in Birds these expansions are of a different nature; they are formed of stiff feathers, which require to be fixed only at the base; and the hand, consequently, no longer presents the division into fingers, which would impair its solidity without being of any use; it has the form of a flattened, and almost motionless stump. The conformation of the arm and fore-arm differs little from that of the same parts in Man; the humerus has no peculiarity; the radius and ulna cannot turn on one another, and are generally longer as the flight is more powerful. The carpus is composed of two small bones placed together, and followed by the metacarpus, which is formed of two bones united at their extremities; on the radial side of the base of this last part, is inserted a rudimentary thumb; and lastly, at its extremity is a middle finger composed of two phalanges, and a small filament representing the outer finger.

Fig. 181.—Bones of Jer-Falcon's Wing: I, elbow joint; II, wrist-joint; III, knuckle-joint; *a*, humerus; *b*, radius; *c*, metacarpus; *o*, rudimentary thumb; 1, 2, 3, 4, rudimentary phalanges of fingers.

331. The wing feathers are distinguished as *primaries*, *secondaries*, or *tertiaries*, according as they are supported by the *hand*, the *fore-arm*, or the *humerus*; and it is on their length, more than on that of the wing bones, that the extent of the wings and the power of flight depend. Whenever the Bird

wishes to strike the air, it raises the humerus, and with it the wing still folded; it then unfolds this by extending the fore-arm, as well as the hand, and suddenly depresses it; the air, resisting this movement, furnishes the Bird with a point of support on which it raises itself; it then darts forward like a projectile; and an impulse being once given to the body, it slants or folds back the wing, to diminish as much as possible the new resistance, which the surrounding fluid makes to its course. This resistance, and gravitation which tends to make all bodies fall toward the centre of the earth, gradually diminish the speed which the Bird has acquired by this stroke upon the air; and without new movements it will soon fall; but before the speed acquired by the first stroke of the wing is lost, the Bird gives a second which adds new speed to that which it already had, and thus proceeds with an accelerated motion. This is, in fact, the mechanism of flight. While the Bird is thus suspended in the air, its wings support all the weight of its body; and to preserve its equilibrium in this position, its centre of gravity must be placed nearly beneath its shoulders, and as low as possible; on this account, during flight, it generally projects its head forwards by stretching out its neck; and its trunk, instead of being elongated like that of the Mammalia, is short and compact.—It is evident that the resistance of the air must be greater, in proportion to the mass of that fluid struck at once by the wings; and consequently, that the greater the extent of the wings, other things being equal, the greater will be the speed acquired by their down-stroke;—thus Birds with long wings will not only be able to fly quicker than those with short ones, but also they will be able to support themselves longer in the air; for they will not be obliged to repeat so often the movement of these organs, and consequently they will be less quickly fatigued. In fact, all the Birds remarkable for their rapid and sustained flight

FIG. 182.—WING OF FALCON.

a, primaries; *b*, secondaries; *c*, tertiaries; *d*, spurious quills, arising from the thumb.

have large wings; whilst those whose wings are short, or of a medium size in comparison with the size of the body, fly with much less speed, and are obliged to rest more frequently.

332. Among the Birds remarkable for the speed of their flight, we may mention the Condor, and the Frigate-Bird (Fig. 304). The Condor, or great Vulture of the Andes, is sometimes thirteen feet across the wings; and rises higher than any other Bird; it is seen sometimes on the sea-shore, sometimes hovering over Chimborazo, that is, at an elevation of nearly 22,000 feet above the first point. Its usual dwelling is on the ridges of the Cordilleras of the Andes, immediately below the limit of perpetual snow, at a level of from 10,000 to 15,000 feet above the level of the sea. It is from these pinnacles that it descends into the valleys and plains to seek its food, which consists principally of the corpses of large Mammalia; it is even said that several together can easily kill oxen, and that they are strong enough to carry off in their claws Sheep and Llamas, and thus transport them to the top of Chimborazo, and the other loftiest mountains of the chain of the Andes. The Frigate Birds, whose wings are longer in proportion to their size, and which dwell on the tropical seas, have so powerful a flight, that they can venture to a distance of more than 400 leagues from land.

333. To rise vertically in the air, it is necessary that the wings of the Bird should be entirely horizontal; but this is not usually the case; they are generally inclined from before backwards, so as to give the animal an obliquely-ascending movement; sometimes this inclination is such, that to rise nearly vertically in the air, the Bird must fly against the wind. The relative length of the wing-feathers influences the facility with which it can rise in calm air; the Birds whose primaries are the longest and most resisting at their extremity, have a more oblique flight than those whose wing is rounded at the end. Thus the Falcons which have pointed wings, can rise only in a zigzag, like a tacking vessel, or by flying against the wind; while Sparrow-hawks, Eagles, and other Birds of prey termed ignoble, whose wings are truncated (or abruptly cut short) at their extremity, can rise vertically (Fig. 182). When the Bird wishes to rise

from the earth, it first springs from its feet, spreading its wings in such a manner as to be able to strike the air before falling back on the ground. Those that have very long wings, require more space to depress them; and if, therefore, their feet are too short to allow them to spring very high, they find it difficult to raise themselves at first. The Swallows are examples of this.

FIG. 183.—WING OF SPARROW-HAWK.
a, third primary; *b*, ninth primary; *c*, secondaries.

334. The feathers of the tail also are useful to Birds, to direct them in their flight; they spread and raise them, or lower them, like a rudder, to increase or diminish the obliquity of their upward course: and by inclining them to one side or the other, they are aided in changing their direction.

335. When the Bird rests on the ground, the posterior members alone serve to support it; it is then truly a biped; and as such it requires a broad pelvis firmly fixed on the vertebral column. The iliac (hip) bones are much developed in Birds; and form only one piece with the lumbar and sacral vertebræ. This bony circle is generally incomplete in front; the pubic bones not meeting on the central line. The thigh bone is short and straight; and the leg is composed, as in most of the Mammalia, of a tibia, a fibula, and a patella; but the two first of these are united together towards their lower extremities. A single bone, which forms a continuation of the leg, represents the tarsus and metatarsus; and bears at its inferior extremity the toes, which are usually to the number of four. They are never more numerous; but sometimes the external, or the internal finger, or even both, disappear, so that only three (Fig. 184), or even two remain (Fig. 185). Three of the four toes are usually directed in front, while the fourth is turned backwards

(Fig. 186); sometimes the outer toe also turns back; this arrangement is to be noticed more particularly among the

Fig. 184.—Foot of Bustard.

Fig. 185.—Foot of Ostrich.

Fig. 186.—Foot of Jer Falcon.

climbers, such as the Parrot, Toucans, Woodpeckers, &c. (Fig. 187).

Fig. 187.—Foot of Parrot.

336. We have said that, during flight, the centre of gravity of the body of the Bird ought to be under the shoulders; but in order that it may retain its equilibrium on its feet, which are situated behind the trunk, these organs must be capable of being brought sufficiently forward, and the claws must be long enough to project beyond the point, where a vertical line would fall, passing through the centre of gravity;—or else this centre must itself be further back, so as to be above the base of support. This explains the reason of the great curvature of the thigh, and the obliquity of the tarsus on the leg;—when the foot is large, and the neck can be so bent back as to carry back the head, the equilibrium is thus established without the body being much removed from the horizontal position (Fig. 188); but when the neck is short, the head large, and the claws of

Fig. 188.—Ibis.

Fig. 189.—Penguin.

moderate length, the animal is obliged to assume during rest or walking, a nearly vertical posture (Fig. 189). It is to preserve their equilibrium more easily, that Birds generally place their heads under their wings while they sleep perched on a single foot. In many of these animals, this position is rendered singularly convenient, by a peculiarity in the construction of the articulation of the knee. In Man and most other Animals, the members bend under the weight of the body, as soon as their extensor muscles cease to contract: and it is the necessity of the

permanent contraction of these organs, which renders a stationary position so fatiguing. But in the Stork, and other long-shanked Birds, it is very different; the lower extremity of the femur presents a hollow, in which is imbedded, during the extension of the limb, a projection of the tibia, which can escape from it only by a muscular effort; the foot once straightened consequently remains extended, without the animal requiring to contract the muscles, and without any fatigue arising from it.

337. It is always more difficult to a Bird to take flight, when it is on the ground, than when it can dart from an elevated point: we have already seen the reason of this; and every one knows that most of these animals *perch* more frequently than they settle on the ground. To maintain themsel[illegible]s in equilibrium on a branch, they must grasp it closely with [illegible] claws; and if it had been necessary to employ for this a consi[illegible]e muscular force, such a position would soon have becom[illegible]guing. But here another very simple mechanism renders all effort nearly useless, and enables the Bird to grasp the branch which supports it, even when it sleeps. The flexor muscles of the [illegible]laws pass over the articulations of the knee and heel in such a m[illegible]ner, that when the latter bend, they necessarily press on the t[illegible]ndons of the muscles, and make them bend the toes; the weigh[illegible] of the body, pressing down the thighs and legs, necessarily produces therefore this movement; and it results from this, that the animal grasps, without effort, the branch on which it is perched, and there maintains itself fixed.

338. Great differences exist in the conformation of the legs, according to the kind of life to which the Birds are destined. Thus Birds that have the power of walking with great rapidity, have very long and powerful legs, and the foot comparatively small; in the Cassowary and the Ostrich (Fig. 179), whose speed is as great as that of the horse, this arrangement is very remarkable; and it is observed also in the Secretary, which walks rapidly while pursuing the Serpents, that constitute its principal nourishment. In the Eagle, the Falcon, the Vulture (Fig. 177), these members are equally strong but short; and the claws are armed with large, sharp, hooked talons, by the aid

of which these Birds seize their prey, either to tear it to pieces on the spot, or to carry it away with them. In Birds adapted to live on the shores of rivers, and to seek by wading the worms and fish which constitute their food; the feet are slender, of extreme length, and bare below the knee (Fig. 286),—an arrangement very favourable to this kind of life, and which has

FIG. 190.—FOOT OF GANNET.

procured for these birds in France the name of *Echassiers* (stilt birds), from *Echasse* (stilt). Again in the kinds formed for [illegible]n deep water, the feet are *palmated*, or webbed; that is, [illegible]rmed into a swimming apparatus, by the addition of a [illegible]rane which extends between the claws without preventing [illegible] from separating; a character which is observable in Ducks, [illegible]s, and a number of aquatic Birds.

9. The sense of touch is but little developed in Birds; the feathers which clothe the whole body oppose great obstacles to the exercise of this faculty, and the peculiar conformation of the organs of prehension is equally unfavourable to it. Taste is more or less obtuse in these animals; their tongue is generally cartilaginous, and destitute of nervous papillæ; and they appear almost always to swallow their food without masticating it. The organ of smell is more perfect, without presenting, however, all the high development which is found in the Mammalia. The nasal fossæ are sunk in the base of the upper mandible, and do not communicate with sinuses; their surface is covered with a very vascular pituitary membrane, and is extended by three cartilaginous plates (analogous to the *spongy bones* of Mammalia, ANIM. PHYSIOL., § 506), turned on themselves and

supported by the sides of the cavity. The posterior nares unite towards the centre of the palatal arch, so as to form in it a single longitudinal cleft. Birds of prey, especially those that live on carrion, have the olfactory organ more developed than granivorous (grain-eating) or insectivorous Birds; most authors assure us that among the former, the delicacy of this sense is such, that it enables them to discover their prey, even when at a considerable distance; but the experiments of some [illegible]alists seem to prove, that in these animals smell scarcely [illegible], and that they are almost entirely guided by sight. The or[illegible] of hearing are less complicated than in the Mammalia; the [illegible]nal ear is generally wanting in Birds; and the auditory ca[illegible]onsists of little more than a membranous tube placed be[illegible]n the os quadratum and a projecting part of the occipital.

340. The organs of sight, on the contrary, [illegible]r more perfect than in the preceding class; the eyes of Bir[illegible] larger in proportion to the size of the head, and some new parts are developed. The retina is very thick, and there proceeds from it a black membrane, folded like a fan, which advances t[illegible] the crystalline lens. Physiologists are not agreed respect[illegible] nature of this appendage, which is termed the *marsupium*. regarded by some as a part of the choroid coat; and by oth[illegible] a nervous prolongation, intended to increase the extent [illegible] visual surface. The pupil is always round; the iris very [illegible] tracted; the cornea transparent, large and convex; and the sclerotic strengthened in front by a circle of bony plates lodged in its thickness. There are two horizontal eyelids, the lower of which is the largest and most moveable; and there is also a third vertical, semi-transparent eyelid, which occupies the internal angle of the eye, and may be drawn across so as to cover its whole surface. There are always lachrymal glands. In many Birds the range of sight is extremely long; there are some which, when raised in the air to heights at which, notwithstanding their size, we can scarcely distinguish them, clearly perceive small animals on which they feed, and pounce upon them with an unerring aim. In these the crystalline lens is less convex and less dense than in the Birds which rise but little from the

ground; and it would seem that the eye can adapt itself to these great differences in the reach of its vision, by the contractions of its motor muscles; which, acting on the bony circle of the sclerotic coat, compress the humours with which the eye is filled, and thus produce distension of the cornea, so as to increase its curvature, when the animal requires to become, as it were, short-sighted for a time, to distinguish clearly very near objects.

341. The Nervous System, which influences the functions of the organs we have just described, presents remarkable peculiarities of structure. The Encephalon is less developed than in the Mammalia; the cerebral hemispheres are still the most voluminous parts of it: but they have no convolutions, and they are not united in a manner as complete; for the great commissure, of which we have before spoken under the name of *corpus callosum*, is wanting in this class. The optic lobes, which in the Mammalia are small, and concealed between the cerebrum and the cerebellum, here, on the contrary, assume a great development, and appear uncovered behind and externally to the cerebral lobes; and instead of being solid, they are hollow like the cerebral lobes. The cerebellum is transversely furrowed by parallel and converging lines; it is formed almost entirely by the central lobe, which, in the Mammalia, is small in comparison with the lateral lobes or hemispheres of the cerebellum; these remain in an almost rudimentary state, especially in Birds that fly badly. The spinal cord of Birds is generally very long, and has two enlargements corresponding with the origins of the nerves of the wings and feet; in those that fly best, the upper enlargement is more developed than the lower; whilst in those that employ their feet more than their wings, there is an inverse arrangement.

FIG. 191.—BRAIN OF OSTRICH.

a, cerebrum; *b*, optic lobes; *c*, cerebellum; *d*, spinal cord.

342. The food of Birds is of various kinds; some feed exclusively on Seeds, others on Insects, others on Fish, others again on the flesh of Mammalia or Birds still living, and some

even on putrid carrion. Their feet sometimes serve for the prehension of their food, but the beak is always the principal organ employed for this purpose; its form varies according to the nature of the food, and according to the more or less carnivorous regimen of these animals; and hence it furnishes the zoologist with excellent characters for classification. A solid horny substance, more or less hard, covers it externally, and renders its edge sharp; but it is never armed with true teeth; hence mastication is very incomplete, and in general there is none whatever. In Birds that live on flesh, and require to tear their prey,—Falcons, Eagles, Vultures, for instance,—the upper mandible is very short, very strong, hooked at the extremity, and terminated by a sharp point; sometimes its edges more or less dentated (or toothed), which makes it a more powerful weapon; and we may judge the habits of these Birds to be more or less rapacious, according to the degree in which it possesses these characters. Thus the *Falcon* is, of all Birds of Prey, that whose beak is the shortest, most curved, dentated, and strong, in proportion to its size; it is also the most intrepid hunter. While the *Kite*, which scarcely differs from the Falcon, except in having a weaker beak, less hooked, and not dentated on the edges, as well as less powerful claws, is naturally a coward; and the *Vulture*, whose beak is still more elongated, and consequently weaker, does not even attack living animals, but feeds on dead bodies. Sea Birds, which feed on the flesh of fish too large to be swallowed at a mouthful, are equally remarkable for their thick and hooked beak (Fig. 193); but it is more elongated than in Birds of Prey, and consequently less powerful. When Birds that feed on Fish, seek only fishes and reptiles small enough to be seized and swallowed with facility, the beak becomes straight, is still more elongated, and resembles a long

Fig. 192.—Beak of Jer Falcon.

pair of pincers. The Kingfisher (Fig. 194) and Stork are good examples of this. Birds that live on Insects, Seeds, or Fruits,

Fig. 193.—Beak of Gull.

have beaks very dissimilar from these; the first have generally a very slender beak, much elongated, and straight or slightly-

Fig. 194.—Beak of Kingfisher.

curved (Fig. 195); unless indeed it is during flight that they capture the small insects on which they feed, for then the beak is short, very wide, and deeply cleft,—an arrangement which we see in Swallows, Goatsuckers (Fig. 196), &c.; this permits

Fig. 195.—Bill of Bee-eater.

Fig. 196.—Bill of Goat-sucker.

Fig. 197.—Bill of Sparrow.

them easily to engulf their prey in their wide throats. Granivorous Birds, on the contrary, have a short thick beak, arched above, or conical, and generally straight, as in the Sparrow

(Fig. 197). A still more remarkable modification of this organ is presented by the Pelicans (Fig. 303), aquatic Birds, that carry between the two branches of the lower jaw a large and very extensible pouch of skin; in which they store up the produce of their fishing, afterwards disgorging it, and feeding on it at their leisure. We must also remark that the beaks of some Birds present singularities of form, the use of which is not known to us; such, for instance, as the kind of helmet on the top of the bill of the Cassowary (Fig. 276); and a similar excrescence on the beak of the Hornbill (Fig. 198).

Fig. 198.—Beak of Hornbill.

343. The tongue is sometimes employed in the prehension of food, as well as in deglutition; and presents remarkable peculiarities of structure. The Os Hyoides, on which it rests, is prolonged backwards in the form of two horns, which rise behind the head, and which give attachment at their extremity to muscles (*m* Fig. 199) fixed anteriorly to the lower jaw; when these muscles contract, they draw these horns downwards and forwards, and consequently push the tongue out of the mouth. This mechanism is particularly curious in the Woodpeckers, and in other Birds which dart out their tongues with rapidity on the insects which constitute their food (Fig. 200). This organ also presents important differences in its form. In the Parrots, which to a certain extent masticate their food, the tongue is thick and fleshy; in Birds of Prey it is broad and

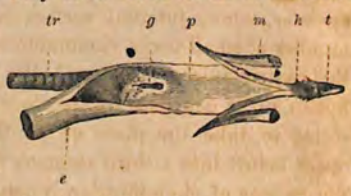


Fig. 199.—Tongue, glottis, &c.; *t*, tongue; *h*, hyoid bone; *m*, muscles; *p*, pharynx; *g*, glottis; *tr*, trachea; *e*, œsophagus.

very soft; in most granivorous Birds it is dry, triangular, and beset towards the base with small cartilaginous points; and in some insectivorous Birds, its extremity is armed with hooks

FIG. 200.—SKULL OF WOODPECKER

or is jagged. The salivary glands are placed under the tongue, and consist of a mass of small rounded follicles; the saliva is generally thick; and sometimes it is quite glutinous.

344. The Pharynx is not separated from the mouth by a movable partition, as in the Mammalia; and has no peculiarities. The Œsophagus (Fig. 201) beginning at the inferior part of the neck, communicates with the first digestive cavity named the *crop;* the sides of which are membranous. The food remains for a certain time in this first stomach, whose form and size vary. It is in the granivorous Birds, that the crop is most developed; it is also found in Birds of Prey; but it is wanting in the Ostrich, and in most Birds that feed on Fish. Below this part the Œsophagus is again contracted, and presents further down a second dilatation, called the *ventriculus succenturiatus,* whose internal surface is perforated by a considerable number of small pores, communicating with follicles that secrete the gastric juice; in general, the size of the stomach is small; but in Birds deficient in the crop it is larger than usual, and seems to take the place of it. The *ventriculus succenturiatus* opens below into a third stomach named the *gizzard;* in which the process of chymification is completed. This varies much in capacity; but it is particularly in the structure of its walls, that important differences appear. In Birds that feed on flesh only, the sides of the gizzard are thin and membranous; but in those that swallow food, which is harder and more difficult to digest, it is furnished with strong muscles, intended to compress

and to grind down its contents. This organ is most muscular in granivorous Birds; the thickness of its fleshy sides is considerable; and its inner surface is covered with a sort of almost

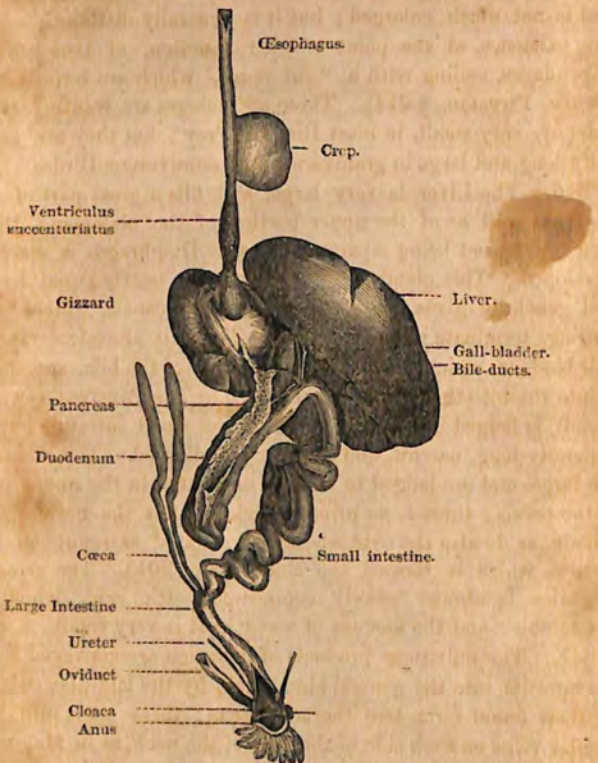


FIG. 201.—DIGESTIVE APPARATUS OF FOWL.

cartilaginous epithelium. Its strength is immense; in the Ostrich for instance, the hardest bodies have been ground down by its contractions; and it evidently takes the place of an apparatus for mastication.

345. The Intestine, which forms the continuation of this

series of stomachs, is much shorter than in most Mammalia; but is composed, as in them, of two portions;—the small and the large intestine. The former, after having taken its first bend, turns in different directions; the second differs from it but little, and is not much enlarged; but it is generally distinguished by the existence, at the point of their junction, of two tubular appendages, ending with a "*cul-de-sac*," which are termed *cæca* (ANIM. PHYSIOL., § 214). These appendages are wanting, or at least are very small, in most Birds of Prey; but they are generally long and large in granivorous and omnivorous Birds.

346. The Liver is very large, and fills a great part of the chest, as well as of the upper portion of the abdomen,—these two cavities not being separated, as the Diaphragm is scarcely developed. This gland is divided into two nearly equal lobes, and generally gives origin to two hepatic canals, which, after uniting, terminate in the intestine. There is almost always a gall-bladder, which receives only a portion of the bile, and sends it into the intestine by a separate canal.—The Pancreas (sweetbread) is lodged in the first bend of the small intestine; it is generally long, narrow, and more or less divided.—The Kidneys are large, and are lodged in hollows excavated in the upper part of the pelvis; there is no urinary bladder; but the ureters terminate, as do also the oviducts, in the dilated extremity of the rectum, which is termed the cloaca (Fig. 201). The urinary excretion is almost entirely composed of uric acid, which is not soluble; and the amount of water in it is very small.

347. The nutritious products of digestion are conveyed from the intestine into the general circulation, by the lacteals; which by their union form two thoracic ducts; these open into the jugular veins on each side of the base of the neck, as in Mammalia (ANIM. PHYSIOL., § 266).—The blood of Birds is richer in red particles than that of the Mammalia; and these bodies, instead of being circular, are elliptical in form. There is nothing peculiar in the manner in which this fluid circulates; and the course it takes is the same as in the Mammalia. The blood passes from the left ventricle of the heart, into the arteries which distribute it to the several organs of the body; it returns into

the right auricle, and from thence is carried to the right ventricle, which sends it to the lungs through the pulmonary arteries; it returns again to the heart, enters the left auricle, and completes the circulation by passing into the left ventricle, from which it set out. The heart has the same form, the same structure, the same

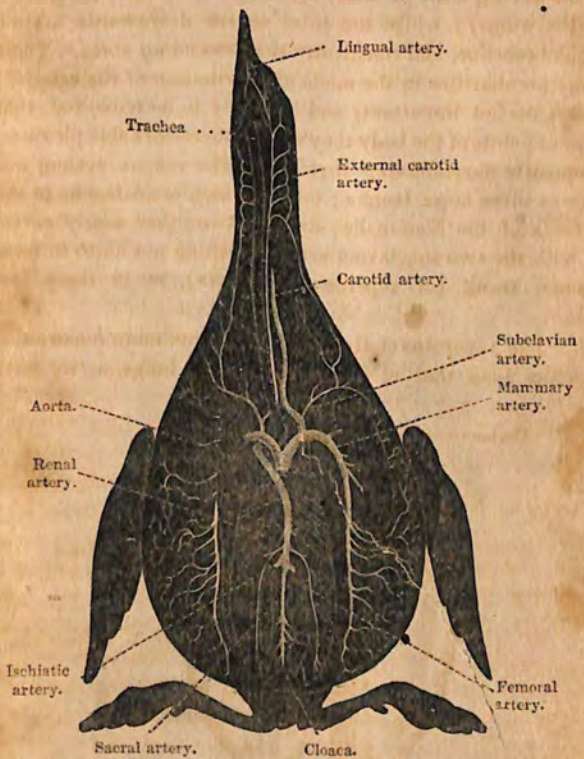


FIG. 202.—ARTERIAL SYSTEM OF BIRD.

position, and the same coverings as in the Mammalia; the walls of the left ventricle are extremely thick, and the right ventricle surrounds it on the right, and below, without prolonging itself to the point of that organ. The Aorta at its origin divides into

three large branches; of which the two first subdivide into the trunks that convey the blood to the head (the *carotid* arteries), to the wings (the *subclavian*), and to the muscles of the chest (the *mammary*, which are of large size in Birds, on account of the great development of those muscles, whose office is to draw down the wings); whilst the third curves downwards around the right bronchus, and constitutes the descending aorta. There are some peculiarities in the mode of distribution of the arteries; but they are not important, and it is only to be remarked, that in different points of the body they constitute remarkable plexuses, by frequently anastomosing together.—The venous system terminates in three large trunks; one of which is analogous to the Vena Cava of the Mammalia; and the two other nearly correspond with the two subclavian veins, which do not unite to form a common trunk (or superior vena cava), as in these last animals.

348. The apparatus of Respiration presents more remarkable peculiarities than that of circulation. The lungs, as we have

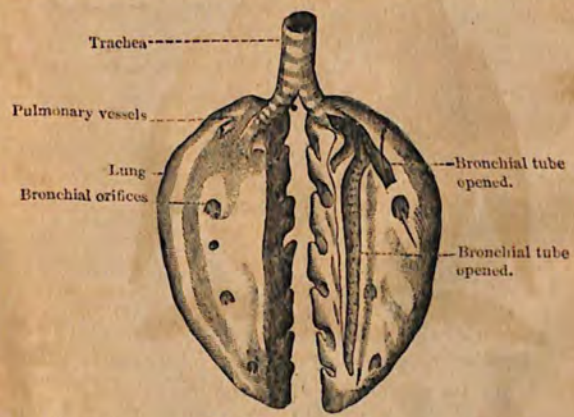


FIG. 203.—LUNGS OF BIRDS.

already said, communicate with large cells hollowed in the cellular tissue, and thus transmit the air into all parts of the body (Fig. 203); so that the respiration may be regarded as double,

—the venous blood coming in contact with the oxygen, when passing through the capillary vessels of the general system, as well as when it passes through the pulmonary capillaries.—The lungs are not divided into lobes as in the Mammalia, and are far from filling the thorax; they adhere to the ribs; and they present at their inferior surface many openings, belonging to the bronchial tubes, which traverse them in different directions, and carry the air into the air-cells distributed among the different organs of the animal. These cavities are formed by membranous partitions, or by laminæ of cellular tissue, and communicate with one another; some are found in the trunk, of very considerable size; and others are prolonged towards the head, and between the muscles of the limbs; the air thus finds its way into every part of the body, and generally also into the substance of the bones. An examination of the air-cells in different Birds, shows that the quantity of air thus distributed into the different parts of the body, varies, other things being equal, in proportion to the energy and continuity of the movements of the animal; thus in Eagles, Sparrowhawks, and other Birds of powerful flight, this fluid penetrates into all the bones; while in those which are destitute of the power of flight, and which walk but slowly, as Penguins, &c., it is excluded from the greater part, or even from the whole of the skeleton. The air is generally in greatest abundance in the bones of the limbs most employed in locomotion; thus in the Ostrich, the femur (thigh-bone) presents a remarkable development of the air-cells.

FIG. 204.—LUNGS OF THE OSTRICH; *a*, the heart; *b*, the stomach; *c c*, the intestines; *d*, the trachea; *e*, the lungs; *f f f*, air-cells, in which are also seen the tubes by which these air-cells communicate with the lungs.

349. Birds have a more constantly-active respiration than any other animals; they consume more oxygen in proportion,

and have least power of resisting the effects of the privation of it. They produce therefore greater heat; the temperature of their bodies rises to 108° or even to 112°; and the feathers with which they are covered are very useful in preventing the loss of heat from their bodies, when they rise to great heights in the air, or when they are partly or wholly immersed in water.—As in the Mammalia, the organ of voice depends for its action on the respiratory apparatus; but the sound is produced at the bottom, and not at the top, of the trachea. As its peculiar structure has been elsewhere described (ANIM. PHYSIOL., § 685), it is not requisite to dwell upon it here.

350. Birds are oviparous, and do not possess, like the animals of the preceding class, mammary glands to suckle their young. The duration of the incubation (or of the time which the young Bird takes to develop itself in the interior) varies in different species, but is nearly constant in each; in the Humming-bird, the smallest animal of this class, it is only twelve days; in Canaries, in a domesticated state, it is from fifteen to eighteen days; twenty-one days for Fowls; twenty-five for Ducks; and from forty to forty-five for Swans. A certain degree of heat is necessary for this operation; that of the sun is sufficient to hatch the eggs of some Birds inhabiting countries between the tropics; but generally it is quite otherwise; and to keep up in the eggs a suitable temperature, the mother covers them with her body, and places them in a bed adapted to shelter them. Some Birds are satisfied with making for this purpose, a rounded cavity in the earth or sand; but most display, in the construction of this kind of cradle, an admirable skill and art; and a point not less remarkable, is the regularity with which successive generations execute the same labours, and build their nests in exactly the same mode, even when the circumstances in which they have been placed have not permitted them to see any others or to take lessons from their parents. They are guided by an admirable instinct, which leads them to take a number of precautions, of whose utility they have no previous knowledge derived from experience. The sides of the nest are usually formed of small flexible twigs, sometimes cemented with earth which has been tempered with the gummy saliva of the animal;

but their form and arrangement vary considerably, as we have elsewhere seen (ANIM. PHYSIOL., § 704.) Nearly all Birds line their nests with soft substances, which they collect with care, or even with a thick and soft down, which they tear from their own breasts. The warm and light substance employed in domestic economy under the name of eider-down, comes from a kind of duck named Eider (Fig. 293) ; which inhabits the isles of the Arctic seas, and which thus strips itself to line its nest with the down torn from its breast.

351. Birds lay their eggs generally once, sometimes twice, a year; in a state of domesticity their fecundity becomes greater. The number of eggs is greater in small species than in large ones ; Eagles lay only two or three at each season; Tomtits and Wrens from fifteen to twenty. The constancy with which Birds sit on their eggs is admirable ; sometimes the two parents divide this labour between them ; in other cases the male is satisfied with providing for the wants of the female, while she is sitting ; and in other species, the whole charge of the incubation rests on the mother alone. In general it is only with reluctance, and when urged by hunger, that she quits her offspring for a few minutes ; and when her young ones are hatched, her maternal affection leads her to lavish on them the most tender cares ; she covers them with her wings to protect them from the cold, and brings them carefully-selected food, which she often disgorges into their throats, after having half-digested it, to render it more suitable to their tender stomachs. She guides their first steps ; teaches them to use their wings ; and when danger threatens, shows in saving them as much courage as devotedness, we may almost say intelligence. There are however some Birds, that lay their eggs in nests which do not belong to them, in order to have them hatched by strange nurses : such as the Cuckoo, which lays its eggs in the nests of Thrushes, Yellow-hammers, Blackbirds, or any other insectivorous Birds, accustomed to feed their young with what would be suitable for the young Cuckoos ; and (which is a remarkable circumstance) the foster-mother becomes a tender and indefatigable parent to these intruders, although they deprive her of her own offspring. Some naturalists assert that the old Cuckoos take care to destroy the

eggs, which they find in the nest where they place their own ; but other observers state that the young Cuckoo itself throws them out of the nest, or drives them away immediately after their birth. The illustrious Jenner, the discoverer of vaccination, tells us that he has often seen the contrivance, by which this little intruder gets rid of its feeble companions ; the young Cuckoo slides under one of the little Birds whose nest it shares, places it on his back, where he holds it by the help of his wings, goes backward to the edge of the nest, and throws it over ; then he recommences the same manœuvres with a second, and so on, until he has made himself master of the dwelling.

352. The instinct which leads Birds to sit on their eggs, is generally one of the greatest power ; yet this impulse, which in some respects is a blind one, is capable of being modified by external circumstances. Thus, Ostriches sit on their eggs, when they inhabit temperate climates ; but leave the incubation to the heat of the sun, when they live in the torrid zone. It would appear also, that several of these large Birds often collect their eggs into the same hole ; and take it in turns to sit on them. The *Mound-Birds* of Australia and the Eastern Archipelago constantly save themselves the trouble of actual incubation, although they bestow the greatest care upon their eggs until the young are hatched. They deposit their eggs in large mounds of decaying vegetable matters collected by themselves, the heat produced by the decomposition of which is sufficient to hatch them.

353. The care which birds bestow on their young, is a subject of observation full of interest ; but it is a more singular, and consequently more remarkable instinct, which leads certain kinds to change their climate according to the season, and to make, at fixed periods of the year, journeys more or less distant. Some kinds migrate in order to avoid the cold, or to seek a less elevated temperature, and go to the south or to the north, to lay, or to pass the period of moulting ; others change their country to procure more easily the means of subsistence, as happens with most insectivorous Birds ; but there are some Birds which take regular journeys, without being influenced by any obvious cause, and without their change of place appearing to produce any appreciable change in their condition. Whatever may be the circum-

stance, which renders the periodical migration of Birds useful to themselves or to their offspring, it is very evident that it is not *this*, which is usually the cause that *immediately* produces the change. Migrating Birds seem to experience, at certain periods of the year, a necessity for changing their place; as they experience at other times a desire of constructing nests, without being led to it by any intellectual calculation, or by the anticipation of the advantages which they will derive from it. It is a blind instinct which guides them; and which sometimes developes itself independently of everything, which would at the time influence the well-being of the animal. Thus in experiments made on some Birds of Passage, this need of change has shown itself strongly at the usual time, though care has been taken to maintain around them a constant temperature, and to give them proper food; individuals having been selected for the experiment, that had not yet formed the habit of migrating. When they change their climate, they do not wait until the cold is become insupportable to them, and are not gradually driven towards the south by the approach of winter; but they precede it, and go almost at once into tropical climates. They frequently return in spring, when the temperature is much below what it was at their departure; and in certain kinds the migrations do not correspond with any distinguishable external circumstance. This phenomenon is therefore inexplicable; but in this it does not differ from all those determined by *instinct*; and as we advance in the study of animals, we shall meet with many examples not less interesting and incomprehensible.

354. But because migrations depend on an instinctive and blind impulse, we must not conclude that external circumstances are without influence in developing in these Birds of Passage the need they feel of change of place: it is remarked on the contrary, that this phenomenon generally coincides with atmospheric variations; and that the time of arrival or departure is often hastened or delayed, according to the cessation or continuance of the cold.

355. The time at which Birds of Passage arrive in our country, or quit it, varies according to the species. Natives of the northern countries of Europe come to us at the end of autumn

or the beginning of winter; and in the first fine weather, avoiding our heat, as they had done excess of cold, they return to lay their eggs in the north. Other Birds, which are born in our own country, and which may be considered as properly belonging to it, quit us in autumn; and after passing the winter in warm climates, they revisit us in the spring, or perhaps, avoiding the moderate warmth of our summer, they emigrate to Arctic regions. Others again, natives of southern climates, come to the north to escape from the ardour of a summer's sun; and arrive in the midst of our own fine weather. There are also some which never remain in temperate countries, but merely pass through them in their annual migrations. The time of the arrival and departure of these travellers, is generally fixed definitely for each species; and experience teaches us that, in certain localities, sportsmen may depend on the arrival of such and such Birds at a given time, as certainly as on rent which is due on a regular day. Age causes however some difference; the young seldom set out till after the old Birds; this seems to arise from the circumstance, that moulting takes place in them at a later period; so that they are not sufficiently recovered from the malady which attends this phenomenon, to endure the fatigues of such a journey, at the time when the old Birds are ready to undertake it.

356. Another fact not less curious in the history of Birds, is the power by which they direct their course in unknown countries, and distinguish, at immense distances, the direct course to their nests. Carrier Pigeons afford a remarkable example of this sense or instinct, quite incomprehensible to Man: Swallows furnish another instance. These little Birds make very long journeys at the time of migration; and yet, by a singular instinct, they know in the following spring how to find again the places where they had formerly established themselves, and always return to them. This fact has been ascertained, by attaching to the feet of several Swallows small silken threads, to establish their identity. They build their first nest near that in which they were born; the Chimney-Swallow makes its nest every year above that of the preceding year; and the House-Swallow establishes itself in that which it had quitted the autumn

before. Spallanzani, a celebrated Italian physiologist of the last century, saw the same couples return to their old nests, almost without taking the trouble to repair them, for eighteen years consecutively. Swallows show, on other occasions also, a singular power of directing themselves towards a particular place, from which they are at a considerable distance. If a hen that is sitting is carried to a distance, shut up in a cage, and her liberty is then given her, she first rises to a considerable height, as if to reconnoitre the country, and then flies in a straight line to the spot where she has left her brood. Spallanzani repeated this experiment successfully on several occasions; and saw a couple of River-Swallows that he had carried to Milan, return in thirteen minutes to their young ones left at Pavia.

357. The instinct of sociability is also much developed in certain Birds; we have elsewhere had occasion to speak of the manner in which several of these animals unite in the construction of their habitations (ANIM. PHYSIOL., § 710); and we shall bring together, in the later portion of this work, some facts yet more remarkable, in regard to the association of Birds for particular purposes; but we must at present be content with observing, that this instinct is scarcely ever developed, except in species living on insects or vegetable substances; and that Birds of Prey live almost always solitary, or united only in pairs.

358. Birds, as well as Mammalia, vary in the manner of procuring their food; most seek it only by day; but some are nocturnal or crepuscular (flying only by twilight); and it is worthy of remark, that they have generally dark colours and downy plumage, so that their wings strike the air without noise; as if the Creator, in his infinite providence, had wished to favour these Birds in their nocturnal pursuit of food. The several species of the families of Owls, Goatsuckers, &c., present examples of this coincidence, between the habits of the Bird, and the nature of the plumage.

359. The number of species of Birds known to naturalists is about five thousand; and, as the organisation of these animals presents great uniformity, the classification of them offers considerable difficulties. The characters employed to divide them into orders, families, and genera, are furnished principally by

the conformation of the beak and feet; organs whose structure corresponds with the diet of the animal. Cuvier, whose method we here follow with little variation, thus divides them into six orders; the RAPTORES, or *Birds of Prey;* the INSESSORES, or *Perching Birds;* the SCANSORES, or *Climbers;* the RASORES, or *Scratching Birds;* the GRALLATORES, or *Waders;* and the NATATORES, or *Swimmers.* To these we shall add the order CURSORES, or *Running Birds*, consisting of the *Ostrich* and its allies; which are included by Cuvier among the Waders, but which differ considerably from them.

I. The RAPTORES, or *Birds of Prey*, are recognised by the strength of their claws and bill; the upper mandible is powerful, bent at the end, and terminates in a sharp point suitable for tearing the flesh of the animals they feed on (Fig. 192); and the toes, equally vigorous, are furnished with strong hooked talons, by which they seize their prey (Fig. 186). The general conformation of the body indicates considerable strength; and their appearance denotes a ferocious character. Some are diurnal, and are distinguished by their dense plumage, and by the lateral direction of their eyes; such are the Vultures, the Griffins, the Falcons, the Eagles, the Sparrow-hawks, the Hawks, the Buzzards, &c. Others are nocturnal, and constitute the family of Owls; characterised by their loose plumage, and by the anterior direction of their eyes.

II. The INSESSORES, or *Perchers*, have weak, slender feet, formed in the ordinary manner; that is, neither palmated, nor armed with strong hooked talons, nor elongated into stilts, and having only one toe directed backwards. (Fig. 205.) Their beak is weak, straight, and with little or no curvature (Fig. 206); their

FIG. 205.—FOOT OF SONG-THRUSH AND GOLDEN-CRESTED WREN.

wings are of moderate size, and they have generally light and slender forms. Some are insectivorous, others granivorous, others again are omnivorous; in this order are classed all Singing Birds, and most Birds of Passage. The number of INSESSORES is immense; we may cite as samples, Magpies, Blackbirds, Linnets, Swallows, Goatsuckers, Larks, Sparrows, Crows, Birds of Paradise, Humming Birds, Wrens, King-fishers, Hornbills, &c.

FIG. 206.—BILLS OF NUTHATCH AND KINGLET.

III. The SCANSORES, or *Climbers*, are Birds which, with the general organisation of the Perchers, have two toes behind and two before (Fig. 187); an arrangement which enables them better to clasp the trunk and branches of trees on which they climb in all directions, sometimes employing even their beak to facilitate their movements. Among these we may class the Toucans, remarkable for their enormous beak, the Parrots, Cuckoos, and Woodpeckers.

IV. The RASORES, or *Gallinaceous* Birds, have a beak of moderate size, arched above, and calculated for a granivorous diet only; the wings are short, the body heavy, the feet of ordinary structure, and the toes weak, but generally united at their base by a small fold of skin. Most of these Birds fly badly, do not perch on trees, and seek their food on the ground. This order is composed of two distinct sections; Pigeons,—and the Gallinaceæ properly so called, comprising the Fowl, Pheasant, Quail, Partridge, Heathcock, &c.

V. The CURSORES, or *Runners*, are distinguished by the absence of wings; and by the conformation of their legs and feet, which enables them to run with rapidity on dry ground. Their legs are usually long, and bare at their lower part, as in the next order; but their feet are not in any degree webbed. They are mostly large Birds; but the number of known species is very small. The Ostrich, Cassowary, and Emu are examples of this order.

VI The GRALLATORES, or *Waders* are recognised by their

very long shanks, and by the nakedness of their legs towards the bottom—an arrangement which makes them look as if mounted on stilts, and which is very favourable both to their rapidity in running, and to their fording deep waters; their toes are long, and are in general slightly webbed (Fig. 207); their figure is usually slender; and the length of their neck is such, that however high they rise on their legs, they can without stooping pick up their food from the ground. Some feed on vegetables, others on aquatic Reptiles, Mollusks, small Fish, &c. Among these are classed river and shore birds, such as Herons, Cranes, Storks, Bitterns, Woodcocks, Ibises, Spoonbills, Avocets, &c.

FIG. 207.—FOOT OF PLOVER.

VII. The NATATORES, *palmated*, or *Swimming* Birds, are characterised by having their legs, which are of moderate length, terminated by broad swimming paddles. These oars are formed by the connection of the toes by a fold of the skin (Fig. 190); and are generally placed very far back; which arrangement renders swimming easy, but walking difficult. We may mention as examples of this group, the Auks and the Penguins, whose wings are so short as to render them useless for flight; the Petrels, Albatrosses, Gulls, and Sea-Swallows, which have, on the contrary, long wings, and a powerful flight; and the Pelicans, Frigates, and Gannets, which are as well organised for flight as the preceding, and which are remarkable for a more complete palmation of the feet; also, Swans, Geese, and Ducks, whose beak is covered with a soft skin, instead of being protected with horn.

360. Of these orders, that of INSESSORES is probably to be regarded as *typical* of the class; since it presents, in the highest degree, all those characters by which the whole group is distinguished,—swiftness of flight, beauty of plumage, powers of song, the small or moderate size of the body, and the high development

of those instinctive propensities, which manifest themselves in the construction of their nests, and in their migrations. It is usual, however, to commence with the order RAPTORES; as being the one that contains the most *powerful* species of the class.

ORDER I.—RAPTORES.

361. The Birds of Prey are for the most part easily distinguished from all others, by their strong, curved, sharp-edged, and sharp-pointed bills: of which the upper mandible is longer than the lower, so as to form a sort of pointed hook, which is very serviceable in tearing their prey; whilst its edge is notched, so as to form a kind of projecting tooth on either side. We shall presently find that the degree in which these characters exist in the several families of the order, corresponds closely with the rapacity of their habits. The body is large and muscular; surpassing in its dimensions that of nearly all other Birds. It is supported upon robust legs, which are generally short (the species which have long legs being *aberrant* forms of the order); and the feet possess four strong toes, one of them directed backwards, which are all armed with long and crooked talons. Their wings are usually large, and their flight prompt, rapid, and powerful; but in this respect there are considerable variations, according to the habits of the several species, and the food on which they are destined to exist. Thus, the true *Falcons* will only devour (except in a domesticated state, or when hard-pressed by hunger) the flesh of other Birds which they have struck down on the wing; and their whole conformation is adapted for rapid and energetic flight. The *Eagles* also are destined to feed upon the flesh of animals recently killed; but they will descend to the earth to obtain it, and often carry off the bodies of Mammalia of considerable bulk; their flight is not so rapid as that of the Falcons, but it is very powerful, in order that they may sustain great weights whilst on the wing. The *Vultures*, on the other hand, gorge themselves on carrion: their

office being to remove the decomposing flesh of the larger animals, which would otherwise poison the atmosphere around. They do not usually attempt to carry away these masses to their nests, but content themselves with devouring as much as their stomachs (which are very capacious) will hold; and they consequently require neither the same *swiftness* nor *power* of flight, that the Falcons and Eagles possess. Lastly, the Owls, which are nocturnal Birds of Prey, obtain their food rather by the stealthiness with which they approach it, than by the vigour with which they attack it; and as it consists of small animals, they do not require any considerable power of flight in order to carry it off. The peculiar nature of their plumage is in manifest accordance with these habits; for the loose downy character of their wing-feathers imparts to their flight an extraordinary noiselessness; whilst it prevents them from striking the air with any force.

362. It is impossible not to recognise the obvious analogies between the different groups of Carnivorous Mammalia, and those of the Predaceous Birds. The bold and powerful Eagles obviously resemble the Lion and the other large Felines; the smaller and yet more active and sanguinary Falcons correspond with the smaller Felines, and with the Mustelidæ; the cowardly carrion-feeding Vultures resemble the Hyæna and Wild Dog; whilst the Owls may be likened to the nocturnal Viverridæ. We shall also find that there are certain species, which are aquatic in their habits; and which are parallel, therefore, to the Otters and Seals.

363. The RAPTORES always associate in pairs; and it appears that the same males and females live together during their whole lives,—instead of pairing afresh every season, which is the case with many Birds of other orders. It is remarkable that, in a large proportion of this order, the female is larger than the male; but the general rule holds good here as elsewhere, that her plumage is less vivid in its colours. The Birds of prey are seldom remarkable, however, for the brilliancy of their aspect; their feathers being generally of a brownish hue, more or less varied with white. They are completely destitute of the power of song; a hoarse cry, or call-note, being all the sound that they

utter. They build their nests in lofty situations, such as the ledges of rocks, the tops of high trees, &c.; and construct them without any great art. They seldom lay more than four eggs;—frequently only two or three; and the young come forth in a blind and feeble state, requiring the assistance of the parent for some time. In this respect, there is another analogy between the Birds of Prey and the Carnivorous Mammalia; the young of which last also come into the world in a blind and weak condition, and are long dependent upon their parents for their nourishment. The task of supporting the young Birds of Prey chiefly devolves upon the female; and it is probably on this account that she is larger and more powerful than the male.

364. The order may be divided into four families, as follows. I. FALCONIDÆ, the *Falcons*, *Eagles*, and *Hawks*, in which the head and neck are covered with feathers; the eyes deeply sunk; the bill short, very strong, and hooked at its point, with the upper mandible more or less toothed; and the talons very acute and strongly curved. In this family, therefore, are most strongly displayed the characters which mark the order; and it is obviously to be regarded as the *typical* group.—II. VULTURIDÆ, the *Vultures*, in which the bill is longer, straight at the base, and slightly or not at all toothed; the eyes are not sunken; and the head and neck are bare of feathers.—III. The GYPOGERANIDÆ, including only a single species, the *Secretary*, which is allied to both the Eagles and Falcons, but differs from both in the extraordinary length of its tarsi, in which it resembles the Waders.—The preceding families, which all agree in the *lateral* direction of their eyes, constitute the division of the *Diurnal* Birds of Prey; the *Nocturnal* division, in which the eyes are directed forwards, consists but of one family;—IV. The STRIGIDÆ, or *Owl* tribe, which is characterised by the downiness of the plumage; the comparative weakness of the beak, and the absence of teeth in the upper mandible; and by the comparative slenderness of the claws, of which the outer one can in general be reversed, so as to bring two against two, and thus to give a firmer grasp.

365. Among the family FALCONIDÆ, we shall first notice

the true *Falcons*, which are the most bold and daring, in proportion to their size, of all the Birds of Prey. They are peculiarly symmetrical in their forms; and their flight is graceful as well as vigorous. Their wings are exceedingly firm in their texture, so as to oppose the most complete resistance to the air; the keel of their *sternum* is extremely prominent, indicating the large size of the pectoral muscles; and the *furcula*, as well as the *coracoid* bones, by which the shoulders are rendered firm, are very strong. None of the bones are very long; and those of the legs, which are not much used for walking, are rather short: but they are firm and well-proportioned; and the processes towards their extremities, whether for giving firmness to the joints, insertion to the muscles, or lever-power to the tendons, are very conspicuous. The bones of the trunk are very firmly knit together; whilst those of the neck and limbs are so united, as to give to these parts great flexibility, in combination with strength. The sight of the Falcons is very acute; enabling them to discern their prey at great distances, and to pounce down upon it with unerring certainty. The wings are pointed,—the primary feathers extending far beyond the secondaries; the two first quills are the longest (the second feather extending somewhat further than the first), and the others are gradually shortened. These pointed wings are not so good for straightforward flight in perfectly still air, as wings which are broader; and therefore, when there is no wind, and the Falcon is desiring to move steadily onwards, its flight is rather in ascending and descending

Fig. 208.—Skeleton of Jer Falcon.

curves, than in a straight line. The same may be observed in the Swallow tribe, and in other birds with pointed wings. But the form and position of the wings adapt these birds to wheel about with great facility; and to gain a lofty elevation with great rapidity, by flying *against* the wind. The attainment of this elevation is the great object of the Falcon in the pursuit of its prey; and when it cannot succeed in coming up with the Bird it is chasing by simple onward flight, it always turns towards the wind, and is then seen to ascend almost perpendicularly. This is on the principle of the *composition of forces*, which has been elsewhere explained (MECHAN. PHILOS., § 161); and which is the same that raises the common paper kite, and keeps it suspended in the air. For the position of the wings being oblique, and the direction of the wind horizontal, the resulting motion is vertical. When the requisite elevation has been attained, the Falcon poises itself for a few seconds, and then *stoops*, or darts downwards with great velocity, striking its prey with its talons.

366. One of the most beautiful and powerful species of the true Falcons, is the *Peregrine Falcon*, which inhabits all the temperate and colder parts of Europe, ranging from Iceland to the islands of the Mediterranean; frequenting high and rocky mountains, and building its nest on the face of precipitous cliffs. It is an extremely elegant bird; the length of the female is about 19 or 20 inches; and the extent of the wings somewhat more than 3 feet. It is met with on several parts of our own coasts, as well as in the mountainous parts of Britain; but it is rarely seen in level districts, and never in the neighbourhood of marshy land. The insulated rock on which Dumbarton Castle stands, has been particularly noticed as a breeding-place of this species. It is an extremely courageous Bird, and attacks other Birds of much larger size. It will sometimes attack the Kite; not, however, to destroy it, but to compel it to yield up its prey. The Gallinaceous Birds, such as Partridges, Pheasants, Quails, &c., furnish the chief supplies of food to the Peregrine Falcon; and from their heavy flight, they become an easy prey to it. But it will also give chase to Ducks, Pigeons, Snipes, and other Birds of much

greater power of wing; and will continue in pursuit of them for many miles. Its forward flight is estimated to be usually at the rate of about 60 miles an hour; but its *rush* or *stoop* is probably at least twice as rapid as this. An instance is on record, in which a Falcon traversed the distance between Fontainebleau and Malta, not less than 1350 miles, in twenty-four hours; in this case, supposing it to have been on the wing the whole time, its rate of flight must have been nearly 60 miles an hour; but, as Falcons do not fly by night, it was probably not more than 16 or 18 hours on the wing, and its rate must have therefore been 70 or 80 miles an hour.—Of all the prey at which the Peregrine flies, the Heron appears the most difficult for it to master. This arises, in great measure, from the height at which the Heron flies; which renders it very difficult for the Falcon to rise above him, or "get the sky of him;" so that, as Falcons can do little or nothing to a Bird above them, the Heron is in perfect safety, as long as he can keep uppermost. Moreover, the Heron can ascend as rapidly *with* the wind, as the Falcon can do *against* it; and thus, during his ascent, he increases his distance from his enemy. Two Falcons are generally sent up in pursuit of the Heron, when both strive their utmost to get above him, and on succeeding in this, immediately stoop upon their quarry. The Heron, however, usually contrives to evade these attacks several times; but as soon as one of the

FIG. 209.—PEREGRINE FALCON.

Hawks has struck him, the other comes to the aid of its comrade, and the two together bring the Heron gently to the ground. It is then, and not, as generally supposed, whilst in the air, that the Falcons are in danger from the formidable bill of their prey. The difficulty which the Falcon has in mastering the Heron, made the *hawking* of that Bird a very choice, and even a royal sport.

367. There are numerous other species of Falcon, of which the *Jer Falcon* is the largest. Of this fine Bird, the male measures about 22 inches in length, and about four feet across the extended wings; and the female is larger. In several points of its structure and habits, it resembles the Eagles. It is a native of the extreme northern parts of both Hemispheres; but Iceland appears to be its head-quarters. It is sometimes seen on the coast of North Britain; but it is not certainly known to breed there.—The *Hobby*, *Lanner*, and *Merlin*, are smaller than the Peregrine Falcon; and the last is particularly distinguished by its elegance of form and plumage, its swiftness on the wing, its courage in attack, and its easy domesticability; qualities which, in the days of Falconry, gained it especial repute as a lady's hawk.—The *Kestrel* is another Falcon, having somewhat the habits of a Kite; it chiefly preys on Field-mice, which it discerns whilst hovering stationary at a moderate height, with the head turned against the wind.

368. The true Falcons were formerly designated as *noble* Birds of Prey, on account of their use in the noble sport of Falconry; the remainder of the family, consisting of Birds which cannot be trained to such employments, received the name of *ignoble* Birds. The Ignoble Birds of Prey are distinguished from the Falcon tribe by the form of their wings and bill. Their longest quill-feather is usually the fourth, the first being very short; so that the wing looks as if its tip had been obliquely cut off. Hence their powers of flight are inferior. Their beak, again, is not so well armed; for instead of having a sharp *tooth* near its point on either side, there is only a wavy edge, or *festoon* about the middle of its length. The bill is generally longer, also, and consequently less powerful; and instead of being curved from its commencement, as in the

Falcons, it is generally straight for a greater or less distance from its base (the part where it is attached to the skull). Although the Falcons are the strongest and most courageous of the whole order, in proportion to their size, yet it is in this division of the FALCONIDÆ that we find the largest and most powerful species.

369. The *Eagles*, which are distinguished by the feathering of the *tarsi* down to the very base of the talons, are pre-eminent in this division of the family, for size and boldness. The species represented in Fig. 210, is an inhabitant of our own country; it is now restricted to the mountainous parts of the North of England, Scotland, and Ireland; but it is more abundant on the Continent of Europe, where it does not confine itself to the mountainous districts, but, in level countries, frequents extensive forests. It is also found in Asia; and it inhabits North America, from the temperate to the arctic regions;—so that it is among the most widely-spread of all species of Birds. It is everywhere regarded as an emblem of might and courage. In ancient times, it was deemed worthy to be regarded as the companion of the gods, the constant associate of Jupiter himself; and it is still regarded as the "King of Birds," holding that rank amongst the feathered creation, which is assigned to the Lion among Beasts. This distinction has probably been conferred upon it, not merely on account of its size, strength, and courage; but also from its habit of soaring to a great height in the sky, and of its frequenting localities which have a great deal of wild grandeur and rude

FIG. 210.—GOLDEN EAGLE.

sublimity about them. The Eagle does not rise in the air so much for the purpose of pursuing its prey on the wing, as that it may be enabled to take an extensive survey of the country beneath; for its food does not consist so much of Birds that pass most of their time in flight, as of those that live on or near the ground, and of such Mammalia as it can vanquish. Thus in one eyrie (or Eagle's nest) in Germany, were found the skeletons of three hundred ducks, and forty hares; but these were in all probability the relics of such prey only, as it could carry to its nest; the carcases of such animals as sheep, fawns, roe-bucks, &c., which were too large to be carried away entire, being torn up and stripped of their flesh, and the skeletons left behind. The astonishingly acute sight of the Eagle enables it to discern its prey at an immense distance; and, having perceived it, the Eagle darts down upon it with a *swoop* or *rush*, like that of the Falcon, and more terrific as its size and weight are greater. The stroke of the foot is sufficient, not merely to dash the animal to the ground, but to dislocate the spine, or fracture the skull, of the smaller Quadrupeds and of those Birds which form the largest portion of their prey. The length of the male Golden Eagle is about three feet, and the expanse of its wings about eight feet. The female is about six inches longer; and the spread of her wings about twelve inches greater. This bird is known to live to a great age; one that died in confinement at Vienna was 104 years old; and, if tradition may be believed, the age of the Eagle in its natural haunts often far surpasses this. In this species, as in all the FALCONIDÆ, the young have a plumage very distinct from that of either of the parent Birds, whose characters they assume about the third year. Hence it has happened, as in many other instances (§ 18), that the young have been described as belonging to a species distinct from the parent. The nest is composed of sticks, twigs, rushes, heath, &c.; and is generally placed upon the jutting ledge of some inaccessible precipice; or, in forests, near the summit of a lofty tree. The young are generally two, sometimes three, in number. Notwithstanding the reputation of the Eagle as a Bird of fierce, unreclaimable disposition, it is by no means

uninfluenced by kind treatment ; and, if taken young and duly fed, it may be gradually brought to familiarity, and even playfulness. Either this, or an allied species—the Imperial Eagle—is employed by the Tartars in the chase of Antelopes, Wolves, Foxes, Hares, &c.

370. There are numerous other species of Eagle, in different parts of the world ; varying considerably in size, and also in habits. Many of them frequent the sea-shore, rather than the inland heights ; and feed upon Fish as well as upon aquatic Birds. These last are termed *Ernes* or *Sea-Eagles ;* and among them may be noticed the *Cinereous* (ash-coloured) *Erne*, which is an inhabitant of the shores of many parts of Britain ; the Chilian Erne (Fig. 211) ; and the *White-headed Erne* of America. They are all

Fig. 211.—Chilian Erne.

distinguished from the true Eagles, by the absence of feathers at the lower part of the tarsi ; as is seen in the accompanying figure. The *White-headed* or *Bald Erne* is the Eagle which is emblazoned as an emblem on the national standard of the United States of America ; it is a Bird of noble size and aspect ; and of great

energy of character. It feeds on young Lambs and Pigs, Ducks, Geese, Swans, and various Sea-Fowl; and, like the Peregrine Falcon, it attacks the Fish-Hawk, when rising into the air with its finny prey in its grasp, forces it to drop this in alarm, and then, suddenly descending, snatches the Fish with its feet, before it reaches the water. The evolutions of the Eagle and Fish-Hawk as they rise in the air,—the one striving for the mastery, and the other to escape with the prey it has just obtained from the sea beneath,—are described by those who have witnessed them, as being really sublime. This Eagle is seldom seen alone, but generally in company with its mate; they hunt for the support of each other, and feed together. The nest is usually placed on some tall tree, and is composed of sticks, clods, weeds, and moss; it measures five or six feet in diameter; and being annually augmented by fresh layers, it is often as much in depth. The young are from two to four in number at each brood; they are at least four years before they acquire their adult plumage; but they pair and breed in the first spring after their birth.—The *Osprey*, or Fish-Hawk, departs still more widely from the true Eagles; being adapted for feeding exclusively upon Fish. The tarsi are covered with scales instead of feathers; and the toes have their under-surface roughened with similar sharp-pointed scales, to enable them to grasp their finny prey more securely. Their wings are long and ample; and the second and third quill-feathers are the longest. The Osprey is widely spread; being dispersed over Europe and a great part of Asia, as well as North America; but it is everywhere a Bird of Passage, breeding in temperate regions, and going southwards at the approach of winter. It is more gregarious (that is, more disposed to associate in numbers) than Birds of Prey generally are; several pairs living in the same neighbourhood, and pursuing their occupation in harmony. Indeed, other Birds are permitted by them to take up their abodes in the interstices of their capacious nests, which are constructed of sticks, sea-weed, grass, turf, &c.; and which, being repaired every year, sometimes becomes a good cart-load. No instance has ever been known of its attacking land animals or Birds, even when pressed by hunger; and hence its presence

among them does not inspire them with alarm. The Osprey is about two feet in length; and about five feet four inches in the expanse of its wings.

371. The *Hawks* constitute another section of the Ignoble Birds of Prey; but, in many of their characters and habits, they present an exceedingly close approach to the Falcons. The beak of the Hawks resembles that of the Falcons in its general form, being curved from the base; but the wings are shorter, and want the pointed tips which are characteristic of that division of the family. As is the case with the Falcons and Eagles, the most powerful Hawks are found in cold latitudes; but they are not so much Birds of the mountain, the storm, and of the free sky,—rather inhabiting hilly countries where there are woods, and seeking their prey near the ground. The Gos-Hawk is unquestionably the finest of the whole tribe; being distinguished alike by its size, the beauty of its plumage, and the elegance of its contour. The female measures about 24 inches in length; the male 19 or 20. It frequents the deep solitudes of forests, preying upon hares, squirrels, and the larger ground Birds; and it builds its nest in lofty trees, preferring, it is said, the fir. Notwithstanding its size and power, it will not attempt to contend with even the smaller inhabitants of the air, such as swallows; for when a number of them attack it together, they drive at it in all directions, and so perplex and annoy it, that it retreats to a sheltered covert. The *Gos-Hawk* was formerly one of the most valued of the Falconer's Birds: it does not rise upon its prey, however, after the manner of the true Falcons; but darts along near the ground, with arrow-like impetuosity, threading

FIG. 212.—GOS-HAWK.

woods, glens, and ravines. It was consequently flown at Birds that chiefly inhabit the ground, such as Pheasants, Land-rails, Pigeons, &c., and also at Hares; and for this purpose it is still occasionally employed. If the prey pursued by it should conceal itself, the Gos-Hawk waits in patience on some perch commanding a view of the spot, until the game flies away; in this manner it has been known to watch a Pheasant for more than fourteen hours. The Gos-Hawk is now rare in the British islands, being chiefly restricted to the Scottish Highlands; but it is more abundant in the forest districts of Continental Europe, and extends also through the temperate regions of Asia and America.—The *Sparrow-Hawk*, though much smaller (the female being only 15 inches in length), is much more daring in its character; and is well known as one of the terrors of the English farm-yard, being very destructive to pigeons and poultry, as also to partridges. No Hawk is more pertinacious in pursuit of its prey than this; for it has been known to follow its terrified victim through open windows, into rooms, barns, and churches, undeterred by the presence of Man. This Hawk builds in trees and thorn-bushes, making a shallow flat nest of twigs; occasionally it occupies the deserted nest of a Crow; and in the Orkneys it breeds on the rocks and sea-cliffs.

372. The *Kites* are much inferior in the strength of their bills and talons; but their wings are very long in proportion to their size; and their tail is forked. They are remarkable for the ease, grace, and buoyancy of their flight; and for their power of remaining for a long time almost motionless upon the wing. They sweep through the air in wide circles, sailing on outspread wings, and using the tail as a rudder; and they often mount to such a height, as to become nearly invisible. Their great elevation serves, as in the Eagles, to give them a wide range, over which they cast their eyes in search of their prey;

Fig. 213.—Kite.

but, having discerned it, they do not make a stoop or rush towards their victim, but skim it (as it were) from the surface of the earth, or even the water, and bear it away in their talons. They habitually feed on moles, rats, mice, young poultry, and small reptiles, but they do not refuse carrion. A very slight show of resistance is usually sufficient to scare them away; as they are by no means courageous Birds, except when defending their young. The common *Kite* or *Glead* (which last name seems derived from the word *glide*, significant of its motion) is found in most parts of England; though it is not now so abundant as formerly. No longer since than the time of Henry VIII., the office of scavenger in London and other towns was chiefly performed by numerous Kites; and at the present time it answers the same useful purpose in Turkey and Egypt. Numerous Kites, in a sort of half-domesticated state, are seen hovering about, or resting on the tops of the houses; and at the signal of a whistle, they descend and clear the ground of any carrion which may have been cast upon it. In India the *Govinda Kite* performs this useful office, and is very numerous even in the large cities. It is described as stooping down in an instant upon any garbage thrown out into the street, and even sometimes intercepting a repast on its way from the cook's shop. It also joins the Crows in their disgusting meals upon larger masses of carrion, and is said rarely to attack its fellow-scavengers. The nest of the Kite is usually in the fork of a thick tree, where it is concealed by the branches; and it is more elaborate in its construction than those of the Birds of Prey usually are. The external part is formed of twigs thickly matted together; and the interior is lined with wool, or some other soft and warm substance. The eggs are generally three in number. The young remain a long time in the nest, and are extremely voracious in their appetite, so that to provide for them requires considerable labour. At this period the audacity of the Kite is greater than at any other. Amongst the different species of Kites, one of the most remarkable is the American swallow-tailed Kite, which is distinguished by its long forked tail, and its habit of preying upon Insects, which it captures in the air like the Swallow.

373. If the Hawks may be regarded as an inferior kind of Falcon, the *Buzzards* may be considered as having the same relation to the Eagles. Their bodies are robust, their wings ample and rounded, and their tarsi more or less feathered,—often to the toes; but they are much inferior in the strength of the bill and talons; though the former, as in the Falcons, is curved from its base. Their flight is easy and undulating; they have neither the soar and swoop of the Falcons, the arrow-like dash of the Hawks, nor the circling sweep of the Kites; but they sail easily and rapidly along, and hunt in quest of moles, rats, mice, young rabbits, reptiles, and insects. The *Common Buzzard* (Fig. 214) is an inhabitant of all the wooded countries of Europe, and of the adjacent parts of Asia; and it is also found in the fur countries of North America. It is a Bird of considerable strength and size; but of no great courage. It usually looks out for its victims from the branch of a tree, on which it perches; and when it perceives its prey, it takes wing, gliding rapidly and silently on its victim. It usually builds its nest in a tall tree, selecting the most retired part of the wood; and it defends its young with great resolution. So strong is this parental feeling in the Buzzard, that females have been known in captivity to hatch and rear the young of other birds. One kept at an inn at Uxbridge hatched a brood of chickens for several years, and always performed the duties of a foster-mother with great assiduity, although she seemed much astonished at the preference which the chicks exhibited for corn over the morsels of meat which she offered

Fig. 214.—Common Buzzard.

them. On a brood of young chickens being given to her, to save her the trouble of sitting, she destroyed them all. (*Yarrell.*) The *Honey Buzzard*, belonging to a different genus from the preceding, is remarkable for the peculiar character of its food, from which its name is derived. This does not consist of honey, however; but of the larvæ of bees, wasps, caterpillars, and other insects,—not to the exclusion of moles, rats, small birds, reptiles, and slugs. It is a very rare Bird in Britain; but it is more common in the warmer countries of Europe, where it is migratory; and it is also found in Asia. It flies low, and runs on the ground with great celerity.—The *Caracaras*, a small group of birds almost exclusively confined to South America, are nearly allied to the Buzzards, and form a sort of transition from these and the Eagles to the Vultures, with which they agree in their carrion-eating habits. There are several species of these birds, which accompany or follow the Vultures in attacking the carcasses of animals which die on the great plains of South America, and one of them is said by Mr. Darwin to be the last bird to leave the skeleton, as it "may often be seen within the ribs of a cow or horse, like a bird in a cage."

FIG. 215.—HONEY BUZZARD.

374. The *Harriers* differ from the Buzzards in the greater length and slenderness of the tarsi; and in the inferior robustness of their bodies, and the length of the wings and tail. The plumage is soft, and of looser texture than in most of the Falconidæ; and the feathers round the face are so disposed, as to

form a sort of ruff, analogous to the disk which is so conspicuous in the Owls. The Harriers are more active, and more constantly on the wing, than the Buzzards; they chiefly frequent open moorlands, over which they skim in search of prey very close to the ground; and they nestle and roost on its surface, building their nests among heath or fern. The *Moor Harrier* (Fig. 216), the largest species inhabiting this country, is commonly known as the Moor Buzzard; it is a native of most parts of Europe, Asia, and Africa; frequenting boggy moorlands and extensive marshes. It feeds upon various kinds of Water Birds, which it surprises by its almost noiseless flight; also upon water-rats, and fish which expose themselves to it by swimming near the surface of the water. It will also feed on carrion; and, like most Carrion Birds, is somewhat gregarious in its habits.

FIG. 216.—MOOR HARRIER.

375. We next pass on to the family GYPOGERANIDÆ, which, as already stated (§ 364), includes but a single genus, the *Secretary Falcon* or *Vulture;* of which we are only acquainted with one species, which is an inhabitant of South Africa. In its general characters, the Secretary approaches some of the Falconidæ, especially those species which feed upon reptiles (§ 364), thus its beak is short and abruptly hooked, and its legs are clothed with feathers much lower down than in the Vultures; to which, also, it has little resemblance in physiognomy. The Secretary was so called by the Dutch, from the plumes at the

back of its head; which reminded them of the pen stuck behind the ear, according to the custom of writing-clerks. The remarkable feature in its structure, by which it is distinguished from all other Raptores, is the extraordinary length of its tarsi, which raise its body above the ground, in the manner of that of the Wading Birds. This conformation adapts it to its peculiar instincts; which lead it to prey upon Serpents and other poisonous reptiles, in search of which it strides over the dry open plains frequented by them. It is further armed with spurs on the elbow-joints of the wings; and these are efficient organs of defence, by which it parries the attempts made by its prey to wound it by its venomous bite, and by successive blows of which it weakens its foe,—destroying it at last by a stroke of its bill, that splits open its enemy's skull. Le Vaillant mentions, that having killed a Secretary, which he had seen to vanquish a Serpent, he found in its crop eleven rather large lizards, three serpents of an arm's length, and eleven small tortoises very entire, —all of which had received the stroke on the head; as well as a number of locusts, beetles, and other insects, very little injured. The Secretary builds its nest on high trees, or in dense thickets; and is not at all disposed to associate with its fellows.

376. We have seen that the Birds of the family FALCONIDÆ have for their office to regulate the numbers of living Birds and small Quadrupeds; and that their head-quarters are in the cold and temperate regions of the globe. The Vultures, and other Birds of the family VULTURIDÆ, on the other hand, are the appointed cleansers of the earth from the dead bodies of such animals as have perished from other causes; and their head-quarters are between the tropics, few of them having any extensive range to the north or south of these lines. Still, however, they are for the most part inhabitants of mountainous regions; and their abodes are often on the confines of perpetual snow. They execute that kind of duty, which no animals but Birds could perform; for although the Hyænas and Jackals may well effect the removal of decomposing carcasses from the open and level country, the dense and tangled forests of tropical regions,

and the almost perpendicular sides of their Alpine ranges, would prove inaccessible to any animals not endowed with the power of flight. Vultures are Birds of enormous spread of wing, in proportion to the weight of their bodies; and even in walking they hold their wings half extended. Their flight is rapid when they have an object in view; but they can also hover with very little effort over a spot near which they desire to remain. The bill of these Birds is hooked at the point, and is straight at the base; their talons are by no means large or strong in proportion to the size of the body, and they are less used than the beak for tearing the food. The character by which they are chiefly distinguished from all other Birds of Prey, is the absence of feathers on the head and neck (Fig. 217); whilst round the bottom of the latter is a sort of ruff of soft or slender feathers, arising from a loose fold of skin, within which they can withdraw the neck, and even the greatest part of the head, while they remain in a semi-torpid state, motionless as statues, during the digestion of their meal. Their whole plumage is deficient in the neat and regular appearance of that of the Falconidæ; but it offers so much resistance, as to be almost impenetrable to shot; and it suffers so little from exposure to alternations of weather, that Vultures in confinement frequently wash themselves thoroughly and hang out their wings to the sun and air to be dried. In these characters and instincts we see an evident adaptation to the mode of life of the Birds which manifest them; for the nakedness of their necks and tarsi prevents these parts from being rendered so foul by the carrion in which they are buried when the Vulture is glutting itself with food, as they

FIG. 217.—TAWNY VULTURE.

would be if clothed with feathers; and a natural instinct seems to guide them to a frequent cleansing of their plumage from the soils which it must receive.

377. Much discussion has taken place with respect to the mode in which Vultures are directed to their food,—whether by the sense of sight or by smell. The probability seems to be, that they have the power of scenting it from great distances, and are thus drawn to the spot in which it is to be found. They are often seen to descend in considerable numbers upon the carcass of a recently-killed animal, "as if they emerged from a cavern in the sky;"—none having been visible but a few minutes previously. But when they are thus drawn *towards* their prey, they are probably directed to the exact spot by the sense of sight. It is certain that the Vultures have an organ of smell more highly developed than that of most other Birds.—They can endure hunger for a long time, and will often sit patiently for many hours, or even days, watching for the death of a sickly or injured animal; they seldom attack it before life is extinct; but when they once begin to devour it, they gorge themselves until the craw forms a large protuberance above the furcula; and they then remain for some time in such a state of stupidity, that they may be knocked down with a stick by any one who approaches them.

378. As interesting examples of this group, the following species may be mentioned. The *Tawny Vulture* (Fig. 217) is a native of the mountainous parts of Southern Europe and Western Asia; its length is upwards of four feet, and its strength very great. Nevertheless it never attempts to carry off in its claws any portion of the carcass on which it is gorging itself; but feeds its young by disgorging the half-digested morsels from its maw. Occasionally it attacks sickly animals, which are incapable of defending themselves; but this is only when no other mode of satisfying its appetite presents itself. The *Egyptian Vulture* is not confined to the country where it is best known; but is a regular visitor of Southern Europe, and has even been seen in this country. Its utility in Egypt and other parts of the East, in cleansing the streets of filth of every

description, has been often alluded to by travellers; and it was fully appreciated by the ancient Egyptians, as we may judge by the frequent representations of this Bird upon their monuments. Its common appellation is Pharaoh's Chicken.—The *Condor* of the Andes is the most remarkable of all the Vultures, in regard to its size and strength, and the great height at which it soars. Its dimensions have been much exaggerated, however; its length being usually somewhat more than four feet, and the expanse of its wings about nine. Its breeding-place and habitual residence is usually at a height of from 10,000 to 15,000 feet above the level of the sea; and it is often perceived soaring at an elevation much above this. Besides feeding on carrion, the Condor will frequently attack young goats and lambs; and when two are in company, they will set upon the Llama, and even the Puma, persecuting the animal until it falls beneath the wounds inflicted by the beaks of its assailants. The Condor, like the rest of the American Vultures, has fleshy wattles about the head and the base of the bill.—The *King Vulture* of the inter-tropical regions of America is much smaller than the Condor; but is remarkable for the brilliancy of its appearance. Its general plumage is of a bright fawn colour; but the quill and tail feathers are glossy black, whilst the ruff round the neck is of a delicate gray. The naked skin of the head and neck is deeply tinged with mingled scarlet, orange, and violet; over the upper edge of the beak hangs a loose comb of bright orange; and there is a circle of scarlet round the eyes, which contrasts singularly with the pearl white of the iris. It is not a mountain Bird; but inhabits the low humid forests, keeping in subjection the Turkey-Buzzard and the Gallinazo, two smaller Vultures which frequent the same localities.

379. Some of the Vultures approach the Eagles in conformation and habits; this is the case with the *Griffins*, which belong to the genus *Gypaëtus*,—a term that includes the Greek names of both Eagle and Vulture. As an example of this group, we may briefly describe the *Lammergeyer*, or Bearded Griffin of the Alps. This is a Bird fully equalling the largest Eagle in size; measuring four feet from the bill to the end of the tail,

and from nine to ten in the expanse of its wings. It derives its

Fig. 218.—Lammergeyer, or Bearded Griffin.

name from a tuft of bristles, that projects downwards on each side of the lower mandible. As in the Eagles, the head, neck, and tarsi are clothed with feathers; but in the characters of the eye, bill, and talons, it agrees with the Vultures. It feeds upon the bodies of animals that have met their death by disease, or by falling down precipices; and is not restricted to those which it has itself slaughtered. Indeed it seldom, unless pressed by hunger, attacks animals which can offer it much resistance; its general habit being to prey upon Hares, Lambs, Kids, and the weak and sickly of the flocks. It is said, however, to destroy more powerful animals, by grappling with them at the edge of some precipice or steep declivity, and forcing them down the abyss; and, when rendered desperate by hunger, this ravenous Bird will even attack Man. Instead of carrying off its prey to the nest, like the Eagle, the Lammergeyer gorges itself with the carcass upon the spot; removing only such parts as it destines for the nourishment of its young. Its flight is sweeping and majestic; and it rises almost to the highest summits of the Alps, when on the outlook for its prey. If it has fixed upon a living animal, it darts down upon it in the manner of the Eagle; but if it be attracted by a carcass, it calmly descends to some neighbouring crag, and then sets out for its repast, flying with heavy wings at a short distance from the ground. A number are usually attracted by the same object; and feed, like the Vultures,

in harmony. The Lammergeyer is an inhabitant not only of the high mountains of the Tyrol, Switzerland, and Germany, but also of the mountain ranges of Africa and Western Asia.

380. The Nocturnal Birds of Prey, constituting the family STRIGIDÆ, or the *Owl* tribe, are distinguished from the preceding by many important peculiarities; besides that difference in the character of the plumage, which has been already adverted to (§ 364): and all these peculiarities have reference to their nocturnal habits. The first thing that strikes us in their appearance, is the large size of the head; this is partly due to the looseness of the plumage with which it is covered; but it also shows itself when this is removed, and is caused by the existence, between the inner and outer tables (or bony layers) of the skull, of a number of large cells, which communicate with the organ of hearing, and render that sense more acute. We find in Owls an external ear, or *conch*, which exists in no other Birds; this is concealed by the feathers, which are arranged in a sort of hollow cone around it; and in some species it is covered with a sort of lid, or operculum, which the Bird has the power of opening or shutting at pleasure. In many species the external ear is much larger than in the one here represented.—The eyes of Owls are very large, and are directed forwards; they are surrounded by two conical disks of feathers (Fig. 220), at the bottom of which the eyes are placed; and these being usually composed of white and shining feathers, doubtless serve to cause the feeble rays, by the aid of which

219.—EAR OF HOWLET.

these animals hunt for their prey, to fall with more power upon the organ of vision. It is in the Owls which are the least nocturnal in their habits, that we find the external ear, and the disks around the eyes, least developed. The pupils of the eyes are very large, and permit so much light to enter, that the Birds are quite dazzled if they open their eyes in full day. The apparatus of flight is feeble in the Owls; since they are not intended to obtain their prey by swiftness of pursuit, but by the stea thiness of their approach. The loose downy plumage of the wings allows a considerable quantity of air to pass through it at each stroke; instead of offering a firm resisting surface, like the wing of the Eagles and Falcons. To compensate in some degree for this, the wings are long; but the muscular apparatus by which they are moved is not remarkable for its power; and the bony framework to which they are attached, is much less firm than in the Diurnal Birds of Prey. The *furcula*, in particular, is very slender. The feet are chiefly remarkable for the power possessed by the external toe, of being turned either backwards or forwards. The digestive apparatus chiefly differs from that of the Falconidæ in the absence of the crop, or craw;* but the gullet is very wide throughout; and the stomach is more muscular than in the Diurnal Birds of Prey.

Fig. 220.—Eye-disk of Howlet.

Fig. 221.—Sternum, &c. of Barn Owl.

* It is stated by Cuvier that Owls have a large crop; but this is an error.

381. The greater part of the Owl tribe are thus adapted to the pursuit of their prey,—which consists in the larger species of hares, rabbits, fawns, birds, &c., and in the smaller of mice, rats, moles, small reptiles and the larger insects,—either by night, or in the dusky twilight; and we find this family most abundant in those parts of the globe where the twilight is most prolonged, —namely, the cold and temperate regions. Nevertheless, there are some members of it (constituting its *aberrant* forms), in which the foregoing characters are much less developed, and in which the habits are rather diurnal than nocturnal; some of these are known by the names of Eagle Owl and Hawk Owl, indicating their resemblance to the Diurnal Birds of Prey. The *Typical* Owls, whose adaptation to nocturnal habits is most complete, appear scarcely capable of motion during the day; they remain at rest upon their perch, with their eyes half-shut or completely closed, presenting a great appearance of gravity; and when attacked, or struck by the appearance of some new object, they do not fly off, but stand more erect, assume grotesque attitudes, and make the most ludicrous gestures.—The family may be subdivided into the three following groups. 1. The *Typical Owls*, which have a large external ear, and large and complete disks around the eyes. 2. The *Horned Owls*, in which the conch, or external ear, is smaller, but the disks around the eyes still large; and in which the head is furnished with two feathery tufts, resembling horns. 3. The *Diurnal*, or *Hawk Owls*, in which the conch is very small, the facial disks wanting, and the feathery tufts absent.—Of the first of these groups, the common *Barn Owl* is a very characteristic representative; it is spread through the temperate and warmer regions of Europe, but is not found in the higher latitudes, where it is replaced by other species. It conceals itself by day in deep recesses among ivy-clad ruins, in antique church-towers, in the hollow of old trees, in barn-lofts, and similar places of seclusion; and at night it sallies forth in search of its prey, which consists of mice, rats, moles, shrews, and large insects. Contrary to the general opinion, this Bird is not unfriendly to the other feathered tribes; it does not attack them, nor do they seem afraid of it;

and it has been found very useful in the neighbourhood of dovecots, in keeping down the rats, which very commonly abound there to the destruction of the young pigeons. Mr. Waterton has noticed that, when it has young to feed, it will bring a mouse or young rat to the nest every twelve or fifteen minutes during the night. Its services to the farmer, therefore, are really very great; and it ought to be encouraged, instead of being regarded as a pest. The superstitious dread of the Owl, which is still commonly entertained, is partly dependent on the dismal sounds it utters; and the time and circumstances under which these are heard. The Barn Owl constructs a rude nest, in which three or four eggs are laid at once; the female often lays a second time before the young are able to leave the nest; and this has been

FIG. 222.—THE GREAT OWL.

known to happen a third time, so that the nest at last contained three broods of different ages.—Many other species, more

or less closely resembling the Barn Owl, are found in different parts of the temperate regions of the globe.

382. It is among the *Horned Owls* that we find the largest Birds of this family. The *Great* or *Eagle Owl* (Fig. 222) is but little inferior in size to the Golden Eagle; and is very destructive to young roes and fawns, hares, rabbits, rats, moles, reptiles, partridges, grouse, and other game. It is chiefly found in the mountainous parts of Central Europe; but it has been occasionally seen in Britain. It frequents deep forest glens; and makes its nest in the fissures of rocks, in ruined castles, and similar places.—A nearly allied species of almost equal size, the *Virginian Horned Owl*, is found in the southern states of the American Union, and a small species is an inhabitant of the south of Europe. Of the *Eared Owls* also there are several species, and some of these hunt in the most daring manner in broad daylight.

383. Of the last subdivision of this family, the *Hawk-Owl* of the northern parts of Europe, Asia, and America, may be regarded as the type. This is the most diurnal of all the Owls in its habits; pursuing birds with great boldness in daylight; and sometimes even snatching game that has been shot by the fowler. It has, indeed, some of the characters of the Hawk; resembling that species in the smallness of the head, the narrow feet, and the prolonged tail; but still the conformation of its feet, and the feathering around its eyes and bill, bring it decidedly within the Owl family. In the character of its plumage, also, it bears a resemblance to the Diurnal Birds of Prey; and, like them, it dashes boldly on its victim, and seizes it on the wing, instead of stealing noiselessly upon it. In summer it feeds principally on mice and insects; but in the snow-clad regions which it frequents in winter, neither of these are to be procured, and it then preys mostly on Ptarmigan,—the flocks of which are followed by it, in their spring migrations to the northward. —Nearly allied to this species, which is about fifteen inches in length, are several others; which inhabit different portions of the globe, and present slight variations in structure and habit. One of these is the *Great Snowy Owl*, which nearly equals the Eagle Owl in size, and is found in the high northern latitudes

of both hemispheres, moving towards the south at the approach of winter, when specimens of it are sometimes found in Britain. In fact, it is said to be a permanent resident in the Shetland Isles.—Another curious species is the *Burrowing Owl*, which is widely spread through the American continent, inhabiting the burrows of the Marmot, Viscacha, and other small Rodentia; and when these do not present themselves, making excavations for itself. It is a small bird; its length not exceeding ten inches. The habit is not altogether peculiar to this species, for even the Barn Owl occasionally takes up its abode in the burrows of rabbits.

Order II.—INSESSORES.

384. The group of *Perching* Birds, included in this order, is the most numerous and the most varied in the whole class. It comprehends all those tribes which live habitually among trees, with the exception of the *Rapacious* Birds on the one hand, and the *Climbing* Birds on the other. From the former they are sufficiently distinguished, by the absence of those characters which have been mentioned as peculiarly marking the Birds of Prey; and from the latter they are at once known by the position of the toes. For in all the true Insessorial Birds, the toes are three before and one behind (Fig. 205); whilst in the Scansores, two of the toes are directed backwards (Fig. 187). The adaptation of the foot of this order to grasping or perching, is evident from the situation of the hinder toe; which is invariably placed on the same level with those in front, and thus distinguishes the Perchers from the Gallinaceous and Wading Birds. These Birds pass the greater part of their time on the wing, and only use their legs as an occasional support; these members are consequently short and weak, in comparison with those of most of the other orders. The toes are slender, flexible, and of moderate length; with long, slender, and slightly-curved

claws. The foot of the common Canary affords a good example of the usual conformation.—On the other hand, the wings are for the most part highly developed; and have often a very wide expanse in proportion to the size of the body, which is never very bulky.—The plumage of the Perchers varies greatly in the different families; being dull in some, and of the most exceeding brilliancy in others. Taken as a whole, however, this order far surpasses all others in the elegance and beauty of the feathered covering; and it contains those species, which are pre-eminent in this respect above all others of the class. The male is nearly always larger than the female, and is more distinguished for the gaiety of his dress. The Perchers live in pairs, and display great art in the construction of their nests, which are usually built in trees, bushes, &c.,—seldom on the ground; the pairing very frequently lasts, however, but for a single season. The number of eggs is usually considerable; and not unfrequently there are two broods produced in every year. The young come forth from the shell in a blind and naked state; and they are wholly dependent for their subsistence on parental care, during some time.—It is to this group that all our Singing Birds belong; with the exception of those contained in the nearly-allied order of Scansores.—Thus we see that among the Insessores are found pre-eminently developed all those characters, which peculiarly distinguish the class of Birds; of which it should therefore be regarded as the *typical* order (§ 360). And it harmonizes well with this view, that it should be by far the largest order of the whole class.

385. There is considerable variety in the food of the Perching Birds; which is, of course, connected with variations in the form of their beak, and in their general habits. In some instances it consists exclusively of winged insects; in others of grubs and worms; in others of soft pulpy fruits; in others of seeds; in others of vegetable juices; in others of small or young birds; in others of carrion; whilst in some it is of a mixed character, the digestive apparatus being adapted to act upon all the foregoing substances. By the form of the beak, this order is divided into four subordinate groups, as follows:—

I. Conirostres, or *conical-billed* Birds; having a strong conical beak (Fig. 223), the margin of which is generally *entire*,—that is, not toothed or indented. The greater part of these are omnivorous; but some are exclusively granivorous (or seed-eating). The *Crows*, *Starlings*, and *Finches* are examples of this group.

Fig. 223.—Bill of Grosbeak.

II. Dentirostres, or *toothed-billed* Birds, which are characterised by a notch or tooth near the extremity of the upper

Fig. 224.—Head of Shrike.

mandible (Fig. 224). These feed on Insects, small Birds, &c. The *Shrikes* or Butcher Birds, *Thrushes*, *Warblers*, *Tits*, &c., belong to this division.

III. Tenuirostres, or *slender-billed* Birds, which have a long slender bill, specially adapted for sucking up vegetable juices

(Fig. 225). The *Humming Birds* are the most characteristic examples of this group; to which belong, however, many Birds whose principal food consists of insects.

Fig. 225.—Humming Bird.

IV. Fissirostres, or *gaping-billed* Birds; in which the beak is very much depressed (or flattened horizontally), so as to give it an extremely wide opening, when the mandibles are separated (Fig. 226). The purpose of this conformation is to allow these Birds to capture insects on the wing; we have a good specimen of it in the *Swallow*, and a still better one in the *Goat-sucker*.—Of the very numerous families included in these groups, our limits prevent us from noticing more than the most important.

Fig. 226.—Head of Goat-sucker.

Tribe I.—CONIROSTRES.

386. The Birds of this division are for the most part distinguished from the rest, not only by the form of the bill, but also by that of the feet; which are so constructed, that they can walk upon the ground with nearly the same facility as they perch upon branches. This faculty is of great assistance to them in the search for food; which they chiefly obtain from the surface of the earth, rather than among trees, or whilst upon the wing. The families included in this division are the Fringillidæ, or *Finches;* the Colidæ, or *Colies;* the Musophagidæ, or *Plantain-eaters;* the Corvidæ, or *Crows;* the Sturnidæ, or *Starlings;* the Paradiseidæ, or *Birds of Paradise;* and the Buceridæ, or *Hornbills.* Most of the Birds belonging to it are more or less domesticable; showing a disposition to associate with Man; and being capable of receiving a certain amount of education from him.

387. The Fringillidæ, or *Finches*, constitute a very large family, that includes several minor groups, such as Larks, Buntings, Linnets, Sparrows, Grosbeaks, Weaver-Birds, &c.; each of these groups consisting of several genera, more or less closely related to one another. None of them are of large size; and they bear a very strong relationship in general appearance and habits. They tenant fields, groves, hedge-rows and woodlands; and they feed chiefly upon various kinds of grain and seeds, occasionally upon insects. Many of them are remarkable for their powers of song; and hence they are termed *hard-billed warblers*, in contradistinction to the Sylviadæ (§ 399), which are spoken of as *soft-billed.* They are for the most part hardy Birds; and as they can usually obtain a sufficient supply of food in our country through the whole winter, few or none of the British Fringillidæ are migratory; although there are several species that are driven hither for the winter from more northern climates. This is the case with the *Siskin* or *Aberdevine;* and with the *Redpoll.* Most of them associate in flocks

during this season, assiduously searching for food; and they are not unfrequently joined by others of a different species. At this

Fig. 227.—Siskin or Aberdevine.

time they show more fearlessness in their disposition, and approach nearer to the haunts of Man, than they do at other times. In consequence of the abundance of their food in the autumn, when the seeds and grains are ripe, they usually become very fat; and thus a store is laid up against the winter, which contributes to maintain their heat (Anim. Physiol., § 412). It is at this period that those species which are employed as articles of food, are most prized; as, for instance, the *Ortolan*, one of the Buntings, which is much sought after on the Continent as a delicacy, and is regularly fattened for the market; and the *Sky-Lark*, of which large numbers are annually taken in the neighbourhood of Dunstable, and sent to the London market, whilst others are brought over from Holland.—The geographical distribution of this family is very extensive, in fact universal; some members of it being found in all parts of the globe where animal life can be supported. Some of the most interesting species will now be noticed.

388. The *Grosbeak*, or *Hawfinch*, is remarkable for the strength of its bill (Fig. 223), which enables it to crack the stones of cherries, and even of olives, with little difficulty; and it chiefly lives upon hard seeds and the kernels of fruit. Its habits are shy and retiring, leading it to choose the most secluded

spots for its nestling-place; and when disturbed, it is said to perch invariably upon the tallest tree in its neighbourhood. It will become, however, very familiar in confinement.—The *Goldfinch* surpasses all other British Finches in beauty and docility; hence it is one of those most frequently kept in captivity. Its

Fig. 228.—Head of Goldfinch; male and female.

song, though soft and pleasing, is deficient in power. It is chiefly remarkable for the beauty of its nest; which is usually in an orchard, large garden, or plantation,—in the neighbourhood of Man, therefore, but not in immediate proximity to him. The nest, for the situation of which a dense evergreen is often selected, is an elegant piece of workmanship; being formed externally of moss, lichens, dry grass, or wool; and lined with hair, and with the down of the willow or of the seeds of various composite plants on which it feeds,—such as the thistle, dandelion, groundsel, &c.—The *Canary*, a native of the Canary islands, is nearly allied to our own Goldfinch in its general structure; though in some respects resembling the Linnets. It has long been bred in confinement in this country; and now appears quite reconciled to its situation, its habits being so completely altered, that it cannot find its subsistence if set free and left to its own resources. The wild Canary, which is still found in Madeira, builds in the immediate neighbourhood of the towns; and is a most delightful songster, much surpassing the domesticated race in power of voice. It breeds very rapidly; hatching five or even six broods, of four or five eggs each, in the course of every season.—The *Bullfinch* is remarkable for the degree in which its voice may be improved by training; its native song is low, soft, and pleasing, but inaudible at a short distance; it may be taught, however, to

whistle airs with great firmness and precision. This Bird feeds chiefly during the winter and spring upon the buds of various trees and shrubs; as the thorn, larch, birch, plum, gooseberry, and other fruit-trees; and it is from this cause very injurious to orchards.—The *Snow-Bunting* or *Snow-flake* is an inhabitant of the Arctic regions; building among the rocks, and finding its subsistence upon the seeds of rushes and other hardy plants. When the violence of the polar winter sets in, however, it is

FIG.—229.—HEAD OF BULLFINCH.

FIG. 230.—SNOW-BUNTING.

driven southwards, and comes in large numbers to the various countries of the north of Europe. After their long flights, they are usually much exhausted; but they soon recover and become fat, and are sometimes called the Ortolans of the North. They usually return northwards in February and March. The Snow-flake is a neat and lively little Bird, readily distinguished by its peculiar colouring, in which white is very conspicuous. The winter plumage is of a browner cast; the black and white feathers having a brown margin, which is worn off in summer.—The *Sky-Lark* is placed by some Ornithologists in the Dentirostral group; but its bill seems to indicate that its relationship

is rather with this family (Fig. 231). This delightful songster is very widely spread over Europe, Asia, and the north of Africa. Its favourite localities are extensive arable lands and open meadows ; but it also frequents wild mountain pastures. Its foot is of peculiar construction, being remarkable for the great length of the claws, especially of the hinder one ; by this it is adapted to walk over uneven surfaces, and to spring from the ground to a height sufficient to cause the wings to act. This conformation destroys the *perching* characters of the foot ; and in fact the Larks reside but little among trees, and merely stand upon the branches as points of observation. Their food consists of insects, worms, grains, and other seeds ; the leaves of the clover and of various wild plants ; and they are of considerable service to the farmer, in destroying much that would be injurious to him. The clear and animated song of the Sky-Lark is mostly uttered whilst the Bird is rising spirally in the air ; but it sometimes sings while resting on the ground. Contrary to the usual habit of the Insessores, the nest of the Sky-Lark is placed upon the ground ; and is very rudely put together.

Fig. 231.—Head of Sky-Lark.

Fig. 232—Foot of Sky-Lark.

389. The *Tanagers* constitute a very interesting subdivision of this family, peculiar to the New World ; where they may be considered as representing the Finches, &c., of Europe and Asia.

They much resemble these in general conformation, but are remarkable for their gaiety of plumage, which is particularly to be noticed in those species that inhabit the tropical portions of America. The number of species is very large; and the differences between them are usually but very slight,—though they are such as adapt them to those varieties of climate, food, &c., which any widely-spread tribe of Birds must necessarily encounter. Among other points of difference between the Tanagers and the Finches of temperate climates, we may notice the mode

Fig. 233.—Organist Tanager.

of breeding. The nests in the former group, as in the latter, are in general elaborately formed; and are constructed externally of small twigs and bits of the stalks of plants, and lined internally with wool, feathers, or down. The eggs, however, instead of being five or six in number, are only two or three; but there are two or more broods in the year. This is very common among Birds of tropical climates; and it is not difficult to understand the purpose of the arrangement. The length of the day between the tropics never varies very much from twelve hours; and the twilight is very short: and, further, there is an ample supply of food throughout the year. On the other hand, the length of the day in temperate climates, during the usual breeding season, is much greater; and it is only at that period, that a sufficient

amount of food can be readily obtained. It would be difficult for the tropical Birds to find enough nourishment for a numerous offspring, during their short day; and the Creator has wisely ordained, therefore, that their brood should be divided, as it were, into two or more, and reared at different periods of the year. But if this were the case with Birds of temperate climates, the second brood could seldom be reared, for want of food and warmth.—The species of Tanager represented in Fig. 233, receives its name from its musical powers, which are greater than those of most others of the group, though far from equalling the Finches and other songsters of temperate climates.

390. Two other interesting genera of this family must be noticed. One of these is the *Vidua*, or *Whidah Finch*, which is remarkable for an astonishing development of plumage in the male, during the breeding season. At other times the male resembles the female. These beautiful Birds are natives of

Fig. 234.—Whidah Finch.

Western Africa, and are particularly abundant in the kingdom of Whidah,—whence their name. The term has been corrupted, however, to *Widow-bird*; which was thought not inappropriate, as if the splendid tail of the male dropped off, after the breeding season, in melancholy for the loss of its mate.—The genus *Loxia*, or *Crossbill*, is an extremely remarkable one, on account of the

peculiar conformation of the bill, which is represented in the accompanying figure. The use of this singular structure, which might be at first deemed an imperfection, becomes evident when the habits of the Bird are watched. Its principal food consists of the seed of the Pine and Fir, which is concealed beneath the hard scales of which their *cones* are formed. In order to extract them, the Bird fixes itself across the cone; and then, bringing together the points of the mandibles (which are much compressed), it insinuates them beneath the scales of the cone. When this has been accomplished, the Bird separates the mandibles, not by opening the beak in the usual way, but by drawing the lower mandible sideways, which it is enabled to do by a peculiar arrangement of muscles: when the scale has thus been raised up, the tongue is brought forwards; and a peculiar horny scoop, with which it is furnished, is directed beneath the seed, which is dislodged and carried to the mouth. The common Crossbill breeds in this country, but is much more abundant in the large pine forests of Germany, Sweden and Norway; and vast flocks are not unfrequently driven thence by the severity of the winter, to find shelter in the southern parts of Britain. It feeds upon other seeds, as well as those of the Pine and Fir; and shows the enormous strength of its bill (its small size being considered), in extracting the kernel from the hard shell. When placed in a cage, it shows great restlessness and impatience; and exhibits much dexterity in drawing forth the ends of the wires from the woodwork, so as to set itself free.

Fig. 235.—Head of Crossbill.

391. The family of Colidæ, or *Colies*, consists of African and Indian Birds, which dwell in bushes and thickets, living in flocks, and feeding on fruits and buds. They are bad fliers, and do not walk well on the ground; but run along the branches of trees with facility. They are chiefly characterised by the form of

their bills; which are short and stout, and compressed towards the point. When they take their rest, they are said to sleep with the head downwards, suspended by one foot.

392. The family MUSOPHAGIDÆ, or *Plantain-eaters*, is intermediate between the Finches and the Hornbills. It consists entirely of Birds which inhabit tropical Africa, and feed upon soft vegetable substances. Their bills are strong and thick, more or less curved on the top, and the outer toe can be turned back so as to resemble that of a Scansorial Bird. In the true *Plantain-eaters* the base of the bill forms a broad plate rising up on the forehead. The best known species are the *Touracos*, in which this structure does not occur, but the crown of the head is adorned with an erectile crest.

393. The family CORVIDÆ, or the *Crow* tribe, on the contrary, is very widely diffused over the globe; some members of it being found in almost every country except the very coldest; —its general characters are consequently well known. The bill is strong, and is compressed at the sides; and it is covered at the base with stiff feathers, which advance forwards so as to cover the nostrils. In several respects these Birds are to be accounted the most perfectly organised of the whole class; exhibiting a more complete combination of its distinguishing peculiarities, than we meet with in any other group. Thus, their digestive organs enable them to derive nutriment from a great variety of edible substances; the bill being capable of laying hold of almost any kind of food; and the stomach being intermediate between the membranous, or thinly-muscular kind peculiar to the carnivorous families, and the gizzards, or strongly-muscular organs

FIG. 236.—HEAD OF CARRION CROW.

which are possessed by those that feed on hard vegetable substances. The form of their foot, again, adapts them to traverse the fields and pastures with facility, in search of food; whilst they can also perch with security on trees, as well as make their way among the branches;—for the tarsi and toes are moderately long and stout; and the claws are arched and acute. The wings are of that form which ensures a powerful and regular flight; steady without being heavy, and buoyant without wavering; for they are broad and of moderate length, and usually rounded at their extremities. The tail, which is chiefly useful as a rudder to direct the course of the Bird in rapid flight, is short in the species that seek their food entirely on the ground, and long in those which reside chiefly in trees and bushes. Their sight is keen, and enables them to discern objects at long distances; the smell also, in some species, appears to be very acute. Their intelligence is much above that of the generality of Birds; they often show a great deal of sagacity in their natural actions; and they possess an unusual degree of docility.. They are usually of a courageous and active disposition; but are at the same time extremely vigilant and cautious.—Their plumage is rather sombre in most of the species inhabiting temperate climates; but though dark in hue, it is lustrous in its aspect; and many species of tropical climates exhibit considerable brilliancy and variety in their colouring. The Crows and their allies have, more than any other Birds, the power of adapting themselves to a variety of circumstances; by which the wide extent of their distribution is partly accounted for.

Fig. 237.—Foot of Carrion Crow.

394. The *Crows*, properly so called, have their bills rather

arched, and of great strength; and they chiefly live upon the ground, searching for carrion, worms, slugs, the larvæ of insects, &c., which they are of very great service in removing; but, when animal food is not to be had, they will devour grain. To

Fig. 233.—Head of Raven.

this group belong the *Raven*, the *Carrion* and *Hooded Crows*, the *Rook*, the *Jackdaw*, and the *Magpie*, among British Birds; of these the first is the largest and most powerful, and is at the same time the most sagacious and courageous, evincing little dread of other animals, and even of the larger Birds of Prey. It not only feeds upon carrion and grain, but will also attack young lambs, poultry, &c. In its general habits it is not unlike the Eagle; for it resorts to the inaccessible ledges of rocks, tall trees, &c., to construct its nest, and, except when domesticated, it shuns the proximity of Man.—The *Jays* have a shorter bill, which terminates rather abruptly; they usually live in the forests of various parts of the world, and feed upon fruits as well as upon worms and grubs.—The *Choughs* have a longer and more slender bill than most of the family; and in some respects lead us towards the Starlings. They nestle in rocks and towers, and are shy and vigilant. There is only one species of Chough in

Britain, usually known by the name of the Red-legged Crow; it is not a common Bird, being chiefly confined to some parts of the western coast of England and Scotland; in its food and general habits it resembles the ordinary Corvidæ. Other species, inhabiting the Continent of Europe, resort to inland mountain ranges, rather than to the shore; and feed chiefly on insects, berries, &c.

395. In the family STURNIDÆ, or *Starlings*, the bill is usually lengthened, conical, and slender: many of the Birds of this group resemble Crows in miniature; and in their internal structure and general habits, they differ but little from the last family. They feed rather upon worms, larvæ, insects, and fruits, than upon carrion; and are very serviceable to quadrupeds, by relieving them from the attacks of insects that infest them. They are for the most part very docile, and may be taught to sing, and even to speak with great distinctness; though they have little or no song of their own. To this family belongs the *Australian Bower Bird*, whose remarkable habits will be noticed hereafter; and also the *Grakle* of the Indian Archipelago, which is so useful in restraining the multiplication of the Locust (p. 12).

396. In the family PARADISEIDÆ, or *Birds of Paradise*, the bill is lengthened and more slender; hence these Birds have been placed by some in the Tenuirostral group. They are believed to subsist chiefly upon fruits; but insects also form part of their diet. Little is known, however, of their habits; for they are confined to New Guinea and the neighbouring islands, which have as yet been very little explored by Naturalists. They were formerly supposed to have no feet; though their feet are in fact rather strong and large. This strange error originated in the circumstance, that the natives collect them to make ornaments of their remarkable plumes; and generally cut off the wings and feet, to prevent those rigid parts from injuring the delicate feathers. These plumes, which are of very different form and aspect in the different species, usually consist of certain feathers of the shoulder-tufts, or from the tail; which are immensely prolonged backwards, and are very thinly barbed, or even entirely destitute of barbs. Their use is entirely unknown to us.

The species here figured belongs to a group of birds evidently related to the Birds of Paradise, and inhabiting the same countries

Fig. 239.—Epimachus albus.

They are, however, placed by many modern authors with the Hoopoes (§ 418) amongst the Tenuirostral Birds, and they clearly indicate a close alliance between the *Paradiseidæ* and those birds.

397. The last family of the Conirostres is that of Buceridæ, or *Hornbills;* which is remarkable for the very large size of the beak, and also for an extraordinary protuberance with which this is generally surmounted. The beak is arched, and sometimes toothed at the edges: and when, as is sometimes the case, the protuberance is wanting, the upper mandible itself appears as if swollen or inflated with air. The form of the excrescence varies much with age; and in very young individuals there is no trace of it. When cut across, it is found to consist of a very loose bony substance; its interior being traversed in every direction by osseous fibres, the interspaces

between which are filled with air. All the bones of these remarkable Birds are more permeated by air than are those of any other known species; even the phalanges of the toes being penetrated by it. The Hornbills are confined to the warm parts of Asia and Africa. In their general habits, they seem to bear a considerable resemblance to the Crows; their flight is sailing, like that of the Corvidæ; and on the ground they advance by a sort of leaping action, in which they are assisted by the wings. The larger species are very shy and difficult of approach; and they perch on the branches of lofty trees, where their vision can command a wide range. They are omnivorous in their diet; chasing mice, small birds, and reptiles; not disdaining carrion; and resorting to soft vegetable matter when no other is to be had. Like the Toucans, which resemble them in the enormous size of the bill (Fig. 265), they swallow their food whole, throwing it up into the air, and catching it as it falls. They breed in the hollows of decayed trees.

Fig. 240.—Hornbill.

Tribe II.—DENTIROSTRES.

398. In this division of the order, the upper mandible has a notch on either side of the tip, like that of the Noble Birds of Prey; and the diet is almost or completely restricted to animal food,—these Birds being chiefly supported upon insects, worms, &c., but the larger of them feeding also upon small birds, reptiles, &c. The notch is not always deep, and is sometimes altogether wanting; in that case the place of the Bird is known

by the correspondence of its general characters with those of the truly toothed-billed species. But there are many whose characters are so intermediate between those of the Dentirostral and the Conirostral tribes, that they may be placed either in one or the other, with considerable show of reason. In fact, there are no such arbitrary divisions in Nature; and it is in the study of Birds, more perhaps than in that of any other class, that the Zoologist feels a difficulty in strictly defining his genera and families, on account of the gradual passage which is formed between one and another, by intermediate species. It is interesting to observe, that several of the families contained in this tribe are evidently analogous to the principal families of the last. Thus we have in the first instance the SYLVIADÆ, or *Warblers;* a very large family of small Birds, which evidently represent the Finches. The LANIADÆ, *Shrikes* or *Butcher Birds*, the largest and most powerful of the order, are strikingly analogous to the Crows. And the TURDIDÆ, or *Thrushes*, which are like Shrikes with their peculiar characters softened down, may be likened to the Starlings. Besides these, we have in this tribe the MUSCICAPIDÆ, or *Fly Catchers;* and the AMPELIDÆ, or *Chatterers*.

399. The family SYLVIADÆ, or *Warblers*, consists of small Birds which have rather long and slender bills, with the tip slightly curved and toothed; and it contains a large proportion of the species which are most remarkable for their power of song. The *Nightingale* (Fig. 241) will serve as a good example of the general aspect and characters of the group. These Birds are solitary in their habits; feeding on insects, worms, and berries;

FIG. 241.—NIGHTINGALE.

but preferring the former. Most of them, indeed, will not touch vegetable matter, unless driven to it by necessity; and, when compelled to resort to it, they select the softer kinds of vegetable matter, rather than the hard seeds, which are preferred by most of the Fringillidæ. The two families may be generally at once distinguished by the form of the beak, the length and comparative slenderness of which, together with the slight curvature at its point (Fig. 242), are in striking contrast with the short, stout, and straight conical bills of the typical Fringillidæ (Fig. 223). But the Larks and allied species have bills so intermediate in form between these two, that they might be placed in one or the other family almost indifferently (§ 388). The various groups of Sylviadæ are spread over all quarters of the globe; and are destined to restrain the multiplication of the numerous tribes of insects, which would otherwise increase to such an extent as to be destructive to all vegetation. As different localities are assigned to different tribes of Insects, so is a diversity of haunts assigned to the various groups of these Birds. Some confine themselves to the higher branches of trees, some frequent dense humid thickets, some hedgerows, some tall reed-beds, some grassy lawns, pasture lands, and wide commons:—in each place finding the insects most suitable to their appetites. A considerable number of those inhabiting temperate climates are migratory; arriving at their summer quarters at the time when their natural food begins to abound; and retiring southwards when their food begins to diminish, and the air becomes chilly. This is the case, for example, with the Nightingale; which passes its summer in various parts of Europe, from South Britain and the southern part of Sweden to the shores of the Mediterranean; and retires to Northern Africa, Egypt, and Syria, for the

Fig. 242.—Head of Accentor Modularis, or Hedge Warbler.

winter. As is the case with many other migrating Birds, the males precede the females by several days. The distribution of the Nightingale in Britain is very limited; it is absent from Devonshire, whose warm humid climate would seem peculiarly favourable to it; and it has been observed especially to frequent those districts in which the cowslip abounds,—a flower which is seldom or never met with in the county of Devon.

400. This extensive family is sub-divided into numerous subordinate groups, of which little more than an enumeration can be here given. Thus we have first the proper *Warblers*, including the Nightingale, Black-cap, Wood-wren, Kinglet, &c.; which are birds of small size and delicate conformation, feeding on juicy fruits as well as on insects and larvæ; and seeking their food chiefly among trees and bushes, seldom betaking themselves to the ground. They form an elaborate nest; lay from five to eight eggs at a time; and in some instances rear two broods in each season. The *Kinglet*, or *Golden-crested Wren*, is the smallest of our native birds; its length from the tip of the beak to the end of the tail being only $3\frac{3}{4}$ inches; it derives its name from the bright lemon-yellow feathers on its crown, on either side of which is a band of black. It is a very lively little bird, chiefly inhabiting woods and plantations of pine, fir or larch.—Nearly allied to the Warblers are the *Tailor-birds*, whose curious nest has been elsewhere described (ANIM. PHYSIOL., § 705).—The *Wheatears* and *Stonechats* have their bills somewhat depressed (or horizontally flattened) at the base, and the corners of the mouth armed with a few bristles; this conformation points them out as insect-eaters. Their wings are lengthened and pointed; and their tarsi are long, enabling them to leap along the ground in search of their food. They inhabit barren places in various parts of the Old World; and nestle in crevices of rocks, among stones, or in holes in the ground.—The *Accentors*, or *Dunnocks* (or

FIG. 243.—HEAD OF GOLD-CROWNED KINGLET.

which one species is commonly known in this country as the Hedge-Sparrow, Fig. 242), have their bills rather straighter and shorter, and somewhat compressed towards the edges. This conformation shows their relationship to the Conirostral group; which is further manifested by their feeding on small seeds as well as on insects. They are found in both hemispheres; and live chiefly on the ground, seeking their food near the shelter of bushes, to which they retreat when disturbed, and moving with a gait between leaping and walking.—The *Titmice* have short conical bills, with the tips not dentated, and the base covered with a few bristles. They are found in both hemispheres, and are very active little birds, continually flitting from branch to branch, and suspending themselves in all kinds of strange attitudes, whilst seeking for insects among the foliage. Though essentially insectivorous, many of them also feed on seeds of various kinds; and some of them do not disdain carrion. They are petulant, excitable, and courageous in their disposition; defending themselves with energy, and not hesitating to attack birds much larger than themselves.—The *Wagtails* have a lengthened and slender bill; their wings are long and pointed; and

Fig. 244.—Titlark.

Fig. 245.—Head and Foot of Blue-headed Wagtail.

their tail, which they are continually shaking up and down, is long and narrow. Their flight is rapid and undulatory, and buoyant and graceful in the highest degree. Their tarsi are long, and they walk with great celerity; the hind toe is armed with a long claw. They frequent the margins of rivers and lakes, inundated fields, &c.; and they feed on insects and small seeds. They nestle on the ground, among the herbage or in stony places. The *Titlarks* or *Pipits* are nearly allied to these.

401. It is in the family LANIADÆ, or *Shrikes*, that we find the largest and most rapacious birds of the Dentirostral tribe; and it is here, too, that we find the dentation of the bill most distinct, as shown in Fig. 224. In their general habits, many of the Laniadæ resemble the Raptorial Birds; for they sit motionless upon their perch, watching for their prey (which consists of small birds, quadrupeds, and reptiles, and the larger insects), and then suddenly dart upon it. Many of them have the curious habit of impaling the animals they have caught upon a large thorn; and then pulling them to pieces, and devouring them at their leisure. They are said to lie in wait near the insects which have been thus secured; and to dart out upon any Birds that may be attracted by them. Their rapacity causes them to be much dreaded by the smaller birds of their own tribe; many of which exhibit as much alarm at their presence as they would at that of a Hawk. They exhibit great courage in defending themselves and their nests from more powerful enemies; and the parents show great attachment to each other and to their young. It is said that when rendered more than usually rapacious by the wants of their hungry offspring, they will even attack young rabbits, which they destroy by striking the posterior part of the skull with their bills. Like the Raptores, they build their nests at a considerable height from the ground; but they show much more art in their construction. This group is distributed over both the Old and the New World; but the species inhabiting temperate regions are usually migratory. Three are natives of Britain.

402. The birds of the family TURDIDÆ, or *Thrushes*, have

arched and compressed bills, with a less strongly-marked tooth. Their wings are usually long and pointed; and their legs rather long and stout. Their flight is moderately rapid; and their

Fig. 246.—Head of Song Thrush.

advance on the ground is by leaping. Their food usually consists of soft animal and vegetable substances, as fruits, worms, and snails; this we might infer from the comparative weakness of their bills; but there are some divisions of the family, in which the bill is stronger, and the food consists of hard-cased insects and grains. This family is very universally distributed over the globe; its several species being adapted to almost every variety of climate. They generally frequent the fields and pastures in search of their food; but they nestle in thickets and woods. Some species are remarkable for their power and variety of song—as the common *Thrush* and *Blackbird* of this country, and others for their power of imitating almost any sound whatever—which is the case with the *Mocking-bird* of America. This extraordinary songster, which ranges from New England to Brazil, can not only imitate with facility the song of any other Bird, with additional ornaments of its own; but can utter almost any other sound which it has heard,—such as the barking of a dog, the mewing of a cat, the creaking of a wheel, &c., &c. The *Orioles* are a group of this family, chiefly distinguished by the greater breadth of the bill at its base. They are mostly tropical

Birds; but one species inhabits this country during the summer,

Fig. 247.—Head and Foot of Golden Oriole.

and is commonly known as the *Golden Thrush*. They are generally remarkable for the beauty of their plumage, and for their courageous disposition; but they have no power of song. A large proportion of their food consists of fruits.

403. The family of Muscicapidæ, or *Fly-catchers*, is much more limited in its distribution; comparatively few species being found elsewhere than in the warmer portions of the globe. They belong to both hemispheres; but are most abundant in the New World. They are characterised by the breadth and horizontal flattening of the beak; the base of which is armed with stiff bristles, that serve to protect the corners of the mouth from the struggles of the insects that are being swallowed. These characters are best seen in the *Tyrants* of South America; which are very bold and spirited birds, preying not merely on Insects, but also on small Birds; and pursuing them very much in the manner of the Shrikes. The smaller species, however, confine their destructive powers to insects, and bear a general

resemblance to the Warblers in their habits. They seldom alight on the ground, however, being almost incapacitated from moving upon it by the shortness of their legs, and the small size of their feet. Two species, the Grey and the Pied Fly-catchers, are annual visitants of Britain; arriving in May, and departing at the beginning of October; in which interval (as is the case with our other summer visitants) the eggs are hatched, and the young reared.

Fig. 248.—Head and Foot of Tyrant Fly-catcher.

404. The Ampelidæ, or *Chatterers*, have the same depressed beak as the Fly-catchers; but it is somewhat shorter in proportion, and slightly arched. These, also, are mostly found in the warmer regions of the globe, especially in the New World; and they inhabit the low grounds or forests, feeding upon insects, caterpillars, and sometimes upon fruits. Several species are remarkable for their powers of song, which almost equal those of the Nightingale. Only one species visits this country;—the *Bohemian Chatterer*, or *Black-throated Waxwing*, which derives its name from a series of curious appendages to its wing-feathers (Fig. 250), resembling red sealing-wax in colour. This is a very handsome Bird, nearly equalling the Song-Thrush in size, and resembling it in colour. It makes its appearance in Britain at irregular periods; visiting us generally during the winter in large

flocks, and betaking itself to the hedges to feed on their berries.

Fig. 249.—Head of Bohemian Chatterer.

It appears to be spread over the whole continent of Europe during the winter, and to proceed northwards in the spring; hence it has no right to the peculiar designation it has received,

Fig. 250.—Wing of Waxwing.

as the *Bohemian* Chatterer, or Waxwing. The use of the peculiar appendages to its wing-feathers is altogether unknown.

Tribe III.—FISSIROSTRES.

405. In this tribe, we find the characters of the latter families of the preceding, carried to a much greater extent; the bill being extremely depressed, its gape enormous, and its angles being furnished (in the typical forms) with very strong bristles. The feet, too, are very short and weak, as these Birds feed chiefly on the wing; but their powers of flight are very remarkable. They feed principally upon insects, which they pursue and capture in the air; but some of the larger species live on fish. In this tribe are included the Caprimulgidæ, or *Goatsuckers;* the Hirundinidæ, or *Swallows;* the Todidæ, or *Todies;* the Trogonidæ, or *Trogons;* the Alcedinidæ, or *Kingfishers;* and the Meropidæ, or *Bee-eaters.*

406. The Birds of the family Caprimulgidæ are, for the most part, nocturnal in their habits; and they have the soft downy plumage, and the dingy colours, of the Owls. The bill is here extremely remarkable for the width of its gape, which, in the true *Goatsuckers*, extends far beyond the eyes; but it is at

Fig. 251.—European Goatsucker.

the same time extremely weak, and is incapable of seizing anything that requires a firm grasp. The angles of the mouth are

furnished with strong lengthened bristles; and from its interior is secreted a stiff glutinous saliva. The instincts of the Birds are in admirable accordance with these peculiarities of their structure. They come forth in the evening, when the Swallows and Fly-catchers have retired to rest; and, like the Bats, range at no great height from the surface of the earth, skimming lightly and rapidly with almost noiseless flight. But whilst the Bats feed especially on the hard-cased insects (such as the nocturnal Beetles, &c.), the Goatsuckers especially seek the soft-bodied Moths; to which, in the downiness of their covering, the sobriety of their colours, and their nocturnal habits, they bear so strong a resemblance. These they ingulf in their capacious throats; the viscidity of the saliva, and the bristles with which the cleft is fenced, being sufficient to prevent their escape, when they have been once entrapped. The ordinary note of the Goatsucker (often termed in this country the Fern Owl) is a singular whirring sound, which has been compared to that of a spinning wheel, but during flight it sometimes utters a shrill whistle. The foot of this bird is very curiously constructed. The hind toe, as in the Owls, can be brought forwards; and the middle claw of the an-

Fig. 252.—Foot of European Goatsucker.

terior toe is furnished with a long comb-like projection. The use of this peculiar organ is not clearly ascertained; by some it is affirmed that the Bird employs it to clear away the fragments of insects, that may have clogged up the fringe of bristles; by others, that it strikes its prey with its foot, and that this long serrated claw enables it to hold the insect more securely; and by others, again, that it uses the instrument to clean its plumage. The Goatsucker is a solitary Bird, and shy in its habits; it seems to hide itself during the day in fern brakes, and other spots where it can obtain shelter near the ground; and there the eggs, which are

usually few in number, are deposited without any nest.—There is but one species of the whole family in Britain; and this is a summer visitant. Several others are found in America; where one of them is known as the *Whip-poor-Will*, and another as the *Night-Hawk*. A remarkable species is the *Steatornis*, or Oil-bird of South America, which is as large as a fowl, and is said to feed principally, if not exclusively, upon fruits and seeds. It is nocturnal in its habits, and lives in large societies in particular caverns; these are visited by the Indians at a certain season, for the purpose of collecting the young birds, which are exceedingly fat, and furnish an excellent oil when boiled down. The *Podargi* of Australia nidificate in holes and on the branches of trees, instead of on the ground like the ordinary Goatsuckers. One of them is the More-Pork bird of the Australian colonists.

407. The HIRUNDINIDÆ, or *Swallows*, differ from the last family in the closeness of their plumage, the great rapidity of their flight, their diurnal habits, and the narrower gape of the bill, which wants the fringe of bristles at its margin. The wings are very long and narrow, consisting almost entirely of the *primary* feathers; the tail is generally forked. The feet are very short and slender, and are but little employed by the Bird, either for perching or walking; by far the largest portion of its time being spent on the wing. They are purely insectivorous in their diet; and consequently all the species which breed in cold or temperate regions, proceed southwards at the approach of winter. Their migrations are often extremely long; and are performed with very great rapidity,—a large number usually congregating together for this purpose. This family includes two groups,—the true *Swallows*, and the *Swifts*.

FIG. 253.—SWALLOW.

The latter have a very weak triangular depressed bill (Fig. 254), and have all the toes directed forwards in walking; they have obviously, therefore, the nearest alliance to the Goatsuckers. — The former have a stronger bill; and the hind toe is inserted quite at the back of the tarsus. The *Swallows* are remarkable for their extreme activity, and for the elegance of their movements; and these qualities, combined with the attachment which they show to human habitations, render them universal favourites. They nestle in holes; or against the face of rocks, buildings, or trees, in which case they construct a nest of mud, or of twigs held together by a glutinous saliva. Three species are well known in this country as summer visitants:—the Common Swallow; the House, or Window Swallow, or Martin; and the Bank Swallow, or Sand Martin. They resemble each other very closely in their habits; flitting about during the whole day in search of their insect prey; and especially frequenting the neighbourhood of pools, and other spots where insects are numerous. The most remarkable peculiarity of their flight, is the facility with which they turn on the wing; for they can double back, not merely at an angle, but at a very acute angle,—almost, in fact, returning upon their previous course; and this without the least appearance of effort. The two first of the species just named construct their nest against the walls of buildings, building them up of particles of earth attached by their glutinous saliva; but the last burrows into sand-banks, often to a considerable depth,—making the entrance slope upwards so as to prevent the rain from beating into it, and lining the interior with feathers and soft vegetable fibres. The male and female work alternately at the excavation; one feeding, whilst the other is carrying it on.

Fig. 254.—Head and Foot of Window Swallow, or House Martin.

408. The *Swift* has probably the most imperfect feet of any known bird. Owing to their extreme shortness, it is unable to walk, except with a most constrained and hobbling gait, and with the assistance of the wings; and from the same cause, in combination with the extreme length of the wings, the bird cannot rise from a flat horizontal surface, since its body is not sufficiently elevated above it to admit of the first downward stroke of these members (§ 333). The Swift, consequently, never settles on the ground; but alights only in such places as present a brink, or declivity, from the edge of which it can launch itself. The toes are furnished with strong claws; the direction of which is such, that the bird can cling very securely even to a perpendicular surface. It lives habitually, and pursues its prey, at a greater height from the ground than the Swallows; and it con-

FIG. 253.—HEAD OF BLACK SWIFT.

structs its nest at a more lofty elevation, choosing the crevices of steeples and towers, and the crannies of rocks. The nest is composed of twigs, straws, and feathers, carefully arranged, but cemented together by glutinous matter. The height at which the Swifts fly, a good deal depends on the state of the weather. When the atmosphere is pure and dry, their flight is most elevated; for it is then that their insect prey rise highest on the wing. When it is moist, on the other hand, they fly much lower; and sometimes come down so far, as almost to touch the surface of the water over which they skim. The amount of their

FOOT OF BLACK SWIFT.

motion during the long summer days is immense; for they often pass sixteen hours in vigorous continued flight, chasing insects not only for their own support but for that of their offspring; and as the rate of their movement cannot be estimated at less than 100 miles an hour, their day's performance must be at least 1,600 miles. When their flight is continuous in one direction, therefore,—as in their migrations,—we see how immense distances may be traversed, with little more than the average amount of exertion. The Swift is among the last of our Swallows in its arrival, and the first to depart. Two species are known in this country; of which the Black Swift is by far the most common,—the White-bellied or Alpine Swift being a rare straggler. The Black Swift has perhaps the largest expanse of feathers, in proportion to the size of its body, of any Bird; for its length is nearly eight inches, and its breadth across the expanded wings eighteen inches, whilst the weight of its body does not exceed an ounce.

409. The Swallows and Swifts of other countries bear a strong resemblance to our own in their general habits; one of those most worthy of notice is the *Esculent Swallow* of the Javanese, by which are constructed the remarkable nests, that are so much valued by the Chinese as delicacies for the table. The material of which these nests are composed was long a matter of dispute; by some it has been supposed to be a kind of sea-weed; by others, to be derived from the spawn of fishes. It is now ascertained, however, that this substance is secreted by enormously developed salivary glands; a few fragments of grass, hair, and other substances are generally mixed with it. The purest nests consist almost entirely of gelatinous matter, which dissolving readily in water is employed in making rich soups and gravies. In Java the nests are collected at three different seasons, namely, in March, October, and December; those obtained in the two latter months are of the best quality. The collecting these nests is a proceeding of great danger; but a large number of persons are employed in it, as may be judged from the quantity sent to China. About 27,000 lbs. are annually transmitted from Java; and these are of the best quality. A still

greater quantity is obtained from the Suluk Archipelago; and much also from Ceylon and New Guinea. It is calculated that about thirty thousand tons of Chinese shipping are engaged in the traffic; and that the value of their freights is above 280,000*l.*

410. The TODIDÆ, or *Todies*, have a remarkable depression or horizontal flattening of the beak; which is blunt at the end, and has a gape extending as far back as the eyes. They are mostly inhabitants of tropical climates; some groups of the family being restricted to South America and the West Indies, and others to India and the Eastern Archipelago. They are Birds of gaudy plumage and rapid flight; they feed on worms, insects, small reptiles, &c.; and some species also devour berries. The *Rollers* are the only representatives of this family in the temperate parts of the Old World; and they depart considerably from its general form, the bill being much longer and narrower than in the Todies, and hooked at the tip; so that, except in its wide gape and depression near the base, it somewhat resembles that of the Corvidæ. One species, the *Garrulous Roller*, is an occasional visitant of this country; it is about the size of the blue-winged jay, and of rather elegant appearance. Its habits are shy and solitary; but it sometimes associates with Rooks and other Birds, searching the meadows and ploughed fields for food. This bird is much more common in the south of Europe, but even there it appears to be a summer migrant from Africa.

FIG. 256.—GARRULOUS ROLLER.

411. The TROGONIDÆ, *Trogons* or *Curucuis*, have a short conical beak, with the tip, and generally the margins, dentated

or jagged. They are covered with very fine soft feathers; and many of them are beautifully coloured. Their habitation is chiefly in low damp woods, in the tropical portions of America and Asia; they fly early in the morning, and in the evening; and they build in holes in trees. Their food consists partly of insects, and partly of berries; and whilst watching for the former, they will often sit for hours at a time, perched solitarily on the low branches of trees, in the most secluded portions of dense forests. They seem to be stupified by the glare of the sun; and during the day they take so little notice of the presence of intruders, that they may be approached near enough to be knocked down with a stick. Their flight is rapid whilst it lasts, but cannot be long sustained. The *Trogon resplendens* of Mexico is a most splendid Bird; its whole upper surface being of the richest metallic golden green; and the tail being covered by long soft plumes of the same hue. These plumes were made use of by the ancient Mexicans as ornaments for their head-dresses.

412. The Birds of the family ALCEDINIDÆ, or *Kingfishers*, have a long quadrangular* bill; which, but for its wide gape, might be thought to belong to the Conirostral series. The wings are short; and the feet very small; the front toes are united at their base, whence this group has been separated from the other Fissirostres, by the title of *Syndactyli*, which indicates the adhesion of the fingers. The tail is short; and the course in flight seems rather to be regulated by the long bill. These Birds for the most part live on fish, which they transfix with the bill, making use of it as a fishing-spear. The plumage is generally of a brilliant blue or green colour; and very smooth and glossy, so as not to be easily wetted by water. Their nests are situated in holes, in the banks of the streams, from which the birds obtain their food. They are solitary Birds in their habits; not even the male and female of the

FIG. 257.—KINGFISHER.

* Having four sides and angles.

same pair being seen in each other's company, except at breeding time. Their peculiar forms, bright colours, and quick motions, have rendered them very noted Birds from an early period. The only species of this family that inhabits Britain, is the common *Kingfisher* or *Halcyon;* which remains throughout the year in this country, shifting its station occasionally along the margin of the streams and lakes which it frequents,—the freezing of the shallower waters in winter driving it to the deeper. It is at once distinguished from any other of our native Birds, by its large body, short and thick neck, disproportionately long bill, diminutive feet, and abbreviated tail. When watching for its prey, the Kingfisher perches itself upon some overhanging branch, with its long dagger-like bill pointed downwards, and its eye intent upon the water beneath. Suddenly, it darts downwards, plunges headlong into the water, and speedily re-appears with a minnow or other small fish between its mandibles. Without loosing its hold, it passes the fish through its bill until it has fairly grasped it by the tail; and then destroys its life, by smartly striking its head three or four times against the branch, after which it gulps its prey at one mouthful, except when it bears it away to the nest for the supply of the young. The fish-bones, scales, and other indigestible parts are afterwards disgorged by the mouth. Various other species of Kingfisher are found in different parts of the Old and New World.—This family also includes the *Puff Birds* of South America, which feed on insects; pursuing their prey on the wing, in the manner of the preceding families. They have a moderate-sized bill, furnished with bristles at its base; their plumage is smooth and dense, and is puffed out into a round ball, whence their name—The *Jacamars*, also inhabitants of South America, have very long, three-sided, pointed bills, and a brilliant metallic plumage; they, too, feed upon insects.

413. The last family of the Fissirostres is that of the MEROPIDÆ, or *Bee-eaters;* these have long, slightly-arched beaks, and long, pointed wings; and are mostly of a green colour. They associate in flocks, and fly like Swallows; pursuing Bees and Wasps, on which they prey with impunity. They are found

only in the Old World and in Australia; and there is one species which is an occasional summer visitant of the British Isles. This is a very beautiful Bird, about eleven inches in length, and eighteen inches across the wings; its plumage is mostly of a clear sea-green, with a golden-yellow neck, and a half-collar of black. It is tolerably abundant in the south-east of Europe; even there, however, appearing only as a summer visitant. It builds, or rather excavates, its nest in banks remote from human habitations; but in search of food it flies in the close vicinity of houses; and the boys of Crete are said to *angle* for it, by attaching a small fish-hook and line to a Locust or other large insect, and by letting the insect fly whilst the line is retained in the hand.—A considerable number of Bee-eaters inhabit Africa; and other species are found in Asia and Australia.

Fig. 258.—Common Bee-eater.

Tribe IV.—TENUIROSTRES.

414. The Tenuirostral Birds have slender compressed bills, frequently arched; the tongue is often divided at the tip into numerous filaments, and is used for sucking up the honey from the nectaries of flowers; the wings are usually of considerable length, but the feet are very slender, with the exception of the hind toe, which is usually robust, and serves to support the animal whilst it is feeding. These Birds are for the most part of small size and delicate form, and of great variety and brilliancy of plumage. They are almost exclusively confined to the torrid

zone, and to the southern hemisphere, where alone we meet with the typical forms of the group; the few species that are found beyond these limits do not exhibit its peculiarities of structure in nearly the same degree. In this tribe are arranged the TROCHILIDÆ, or *Humming-Birds*, and the CINNYRIDÆ, or *Sun-Birds*,—the families in which the beak and feet are most remarkable for their length and slenderness; and also the MELIPHAGIDÆ, or *Honey-suckers*, the UPUPIDÆ, or *Hoopoes*, and the CERTHIADÆ, or *Creepers*, which are more or less aberrant in their characters, and connect the group with others.

415. The family of TROCHILIDÆ, or *Humming-Birds*, includes the smallest and most brilliant of the whole feathered race (Fig. 225). They are also among those most adapted for rapid flight; the muscles of their wings probably exceeding those of any other known Bird, when compared with the size of the whole body; and the plumage being very dense and compact. From these characters, taken in connection with the weakness of the legs, the Naturalist might at once infer that the Humming-Birds pass the greatest part of their time on the wing; and this inference would be found to correspond exactly with their real habits. The velocity with which they glance through the air, and the rapidity in the vibration of their wings,—so great as to elude the sight,—are most extraordinary; and when hovering before a flower, they seem suspended in the air, rather than sustained by the vigorous movement of their rigid pinions. To this movement is due the constant murmur or buzzing sound, from which the Birds derive their name. They show great courage, and even pugnacity; especially during the breeding season, when under the influence of jealousy. When attacked by larger Birds, they will dart themselves, as it were, against the invaders; directing their needle-like bills against the eyes of their opponents, so as to become very formidable adversaries. The tongue is one of the most curious features in their organisation; being split into two tubular filaments, which are capable of being darted out to a considerable distance, by an apparatus very much resembling that by which a similar motion is given to the tongue of the Woodpecker (§ 343). By means of this

instrument, the Humming-Bird is able to secure both vegetable juices, and the insects which are attracted by them; and from the large quantity of the latter, of which the remains are found in its stomach, they would seem to constitute the principal portion of its food. Indeed certain species of this family appear destined to feed exclusively upon insects; and resort to the webs of spiders, which they rob of the prey that has been entrapped by them. This beautiful tribe is entirely restricted to America; being most abundant between the tropics, and not usually extending far on either side. Some species, however, migrate into the temperate regions on either side of the equator, during the warm season; and stragglers have been seen in very cold situations. They are most numerous in the dense forests of those regions, amongst the wild blossoms which vie with themselves in splendour; but they also frequent the gardens of cultivated districts, and do not appear at all disinclined to the society of Man. Their nests are very beautifully constructed; being usually composed of vegetable down, such as that of the cotton-plant or silk-cotton tree; and being covered on the outside with bits of lichen, leaves, moss, &c.

416. The family of CYNNYRIDÆ, or *Sun-Birds*, may be regarded as representing the Humming-Birds in the Old World; almost rivalling them in brilliancy of plumage, and closely resembling them in general habits. The plumage glitters with metallic reflections; but these do not vary in hue in different lights, as do those of the Humming-Birds,—the same points in which have sometimes the lustre of the emerald, and sometimes of the ruby, according to the direction in which the light strikes them. The Sun-Birds have a lengthened, arched, and finely-toothed bill; and this encloses a slender tongue, which is in some species forked like that of the Humming-Birds, and in others pencilled at its extremity. In either case, it serves nearly the same purpose; the food of these Birds consisting chiefly of vegetable juices, and of the nectar of flowers, both of which are sought in the depths of their blossoms. They are animated, rapid, and graceful in their movements; their disposition is lively, and their song agreeable. In this last respect they have the superiority over the Humming-Birds; whose voice is

nothing more than a shrill cry. The Sun-Birds range over Africa, Asia, and the Pacific Ocean; and certain species, also included in this family, are natives of South America. The *Superb Promerops* of New Guinea is four feet in length, from the extremity of the bill to the end of the tail; the tail being extremely long in proportion to the body, which is delicate and slender. In this respect it is analogous to the Birds of Paradise, which are inhabitants of the same region; and it also resembles them in the metallic lustre of its feathery covering. The head, neck, and under surface of the body are glittering green; and the feathers which cover these parts have the softness of velvet. The back is of a changeable violet hue; and the wings, which possess a velvety texture, appear, according to the light in which they are held, blue, violet, or deep black. The feathers of the tail and of the wing-coverts have the brilliancy of polished steel.

417. In the MELIPHAGIDÆ, or *Honey-suckers*,—a family peculiar to New Holland and the neighbouring islands,—the characters exhibited by the typical groups appear softened down, as it were; so that their conformation is less peculiar. Thus the bill and legs are stronger; and the powers of flight are less conspicuous. The tongue is still adapted for suction; being furnished with a pencil of delicate filaments at its extremity; but it is not nearly so extensible as in the Humming-Birds and Sun-Birds; and the branches of the *os hyoides* do not pass round the skull. Besides the juices of flowers, and the insects obtained with them, many of these Birds feed on berries, for which their greater strength of bill adapts them; and one species is said to pick holes in the bark, and to draw forth insects from these, by means of its long tongue, very much in the manner of the Woodpecker. The Honeysuckers deposit their eggs in cup-shaped nests, placed in the fork of small branches near the ground.

418. Of the more aberrant families of this order, we may first mention that of UPUPIDÆ, or *Hoopoes*, which seems to connect it with the family CORVIDÆ among the Conirostres; for whilst some of the species it includes are evidently allied closely to the groups we have been considering, others (and among these the *Hoopoe* itself) show an affinity to some forms of the Crow

family. The *Epimâchi*, or Plumed Birds, of which a fine species has already been figured (Fig. 239), are now placed in this family, although in many respects, and especially in the splendour of their metallic tints, and the extraordinary development of some parts of their plumage, they approach the Birds of Paradise. The *Rifle-Birds* of Australia are also distinguished by the brilliancy of their plumage. The *Hoopoes*, on the other hand, have much of the habit and appearance of Crows. The bill is used in the same manner, and for the same purposes, as in the Hornbills;—namely, for seizing Insects, &c., squeezing them to death, and throwing them with a jerk into the throat. The tongue is short, and destitute of the power of extension. The legs and feet are larger than in the preceding groups; and are better adapted both for perching and walking. The *European Hoopoe* is an occasional visitant of Britain; it is about the size of the Missel-Thrush, but is readily distinguished from it, not only by its beautiful crest, but by the length and slenderness of its bill, and the shortness of its feet. It is said to frequent ploughed lands and pasture grounds; which it searches, like the Crows, for Insect-grubs, worms, &c.; and it breeds in hollow trees in secluded situations. It is more abundant on the Continent of Europe than in Britain; but its sojourn in temperate climates is but short, as its arrival from warmer regions is late, and its departure early. In Egypt and Northern Africa it seems to be a perpetual resident; and on the banks of the Nile, where it is of great service in keeping down the multiplication of Insects, it becomes very familiar with Man, and builds its nest in the immediate vicinity of his habitations. The

Fig. 259.—European Hoopoe.

name of the Bird seems to be derived from the peculiar sound,—resembling *hoop, hoop, hoop*, very softly and rapidly breathed out,—which it is continually uttering.

419. As the preceding group conducted us towards the Conirostral Birds, so does the family of CERTHIADÆ, or *Creepers*, lead us towards the Insectivorous division of the Perchers,—especially the Warblers, with which some of them have a very close relationship; whilst other species exhibit an equally close relationship to the Birds of the next order, Scansores. They are for the most part adapted to live upon the trunks and branches of trees; and to feed upon the Insects which infest the bark. The form of the bill varies in different species; being long and slender in some; short and stout, and capable of penetrating very hard substances, in others. Their plumage is usually of a dull brown colour. The true *Creepers* have a long slender arched bill, enclosing a long, narrow, sharp-pointed tongue, which is jagged near

FIG. 260.—HEAD, FOOT, AND TAIL, OF BROWN CREEPER.

its tip. The wings are long and rounded; the feet are rather slender, but the hinder toe is long and stout; and the tips of the tail-feathers extend beyond the webs, and are firm and pointed. These Birds cling by their feet to the perpendicular surface of trees, resting upon the stiff quills of their tails; they creep from the base to the summit of the stem, with short jerking

movements; and search every crevice as they ascend. They will even pass round a horizontal branch, clinging to its under-surface with their backs to the ground. When they have ascended one tree and completely searched it, they fly off to the base of another, to search it in like manner. When thus employed, they show little timorousness; and will permit themselves to be approached within a few feet. The species which inhabits this country is a permanent resident, not a migrant; for its food is to be obtained at all seasons. It is very generally distributed over Europe, and seems to be the same with the Creeper that inhabits North America.—The *Nuthatches* have a stronger, straighter and more conical bill; they are for the most part small Birds, and present a considerable resemblance to the Tits (§ 400) in their general habits, as well as in their form, size, and colouring. They are remarkable for restless activity, moving with extreme quickness up and down the branches and trunks of trees, searching for insects in the crevices of bark and among the leaves, clinging and hanging to the twigs, turning with astonishing agility in all directions, and flying from one tree to another in search of their food. Unlike the Creepers, however, they generally descend trees, instead of ascending them; and they usually sleep with their heads downwards. They feed not only upon insects, larvæ, &c.; but also upon acorns, chesnuts, and other hard fruits, which they split or perforate with their strong bills, after having fixed them in a crevice. There is only one species in Europe; and this is a resident in South Britain. It is a very amusing Bird in confinement; but must be kept in a cage entirely formed of wire, as it speedily chips up wood with its bill.—Several other species, more or less closely allied to the foregoing, are found in

Fig. 261.—European Nuthatch.

America; which country seems to be the chief habitation of this family.

420. We are probably also to include in this family the *Wrens;* which have a close alliance to the Gold-crests among the Warblers, but seem on the whole more nearly related to the Creepers. They have a rather long and slender bill, short wings, an elevated tail, and feet of moderate size. Their colouring is usually dull, and not in any case remarkable for brilliancy. They live chiefly on or near the ground, seeking for insects and worms among the low bushes; and they construct a very bulky nest of vegetable substances, such as dried ferns, lined with moss and feathers. They inhabit both Continents; and some of the species are among the hardiest of all the smaller Birds, in resisting extremes of cold. There is only one species of true Wren in this country, and this is widely diffused over Europe; all the others at present known belong to North America. The *European Wren* is one of the most familiarly known of all our small Birds, on account of the liveliness of its habits, as well as its peculiarity of form. Its flight is effected by a rapid and continuous motion of the wings; but it is not long sustained, for the Bird merely flits from one bush to another, or from stone to stone. Sometimes, however, it ascends trees, nearly in the manner of the Creepers. The male has a very pleasing, rich, and mellow song; which is principally heard in spring and summer, but which is occasionally put forth in autumn and on fine days in winter.—Allied to the Wrens is a very extraordinary Bird, probably the largest of the Insessorial order,—the *Mœnura*, or *Lyre-tail* of Australia. This is distinguished by the extraordinary plumage of its tail, the feathers of which rise up on either side, so as to present the form of an ancient lyre,—whence the name given to the Bird. In other respects, however, it bears a strong resemblance both to the Wrens and Thrushes; except in regard

Fig. 262.—European Wren.

to its large size,—equalling that of a Pheasant, which has caused some Naturalists to place it among the Gallinaceous Birds. Its food appears to consist principally of insects, centipedes, snails, &c.; in search of which it strides with ease over loose stones, and the sides of rocky gullies and ravines. It is further distinguished for its vocal powers; for it possesses a loud full note, which may be heard for at least a quarter of a mile; and also an inward warbling song. It is an extremely shy Bird, inhabiting secluded situations, and taking alarm at the slightest unaccustomed sound.

Order III. – SCANSORES.

421. The arrangement of the toes in pairs, so that two of them are directed forwards and two backwards (Fig. 187), is the character by which this order is more particularly distinguished: but the group thus formed scarcely appears to be a really natural one; since the families which possess this character differ from each other in so many particulars, that they do not seem to have any close connection. Their food, habits, aspect, and structure, are so dissimilar, that no general statement is applicable to all of them; except that the form of their feet, which gives them great power of prehension, and thus enables them to cling with firmness to their perch, renders walking more difficult; and that, as they pass most of their time in trees, their powers of flight are usually moderate. This order comprehends the families of Psittacidæ, or *Parrots;* Ramphastidæ, or *Toucans;* Picidæ, or *Woodpeckers;* and Cuculidæ, or *Cuckoos.*

422. The general form and structure of the Psittacidæ is known to every one, from domesticated specimens. They are characterised by their short hard beaks, which are generally highly arched, and surrounded at the base by a naked skin, in which are the orifices of the nostrils. They are natives of tropical and the warmer temperate regions; and they live for the most part upon fruits, seeds, honey, &c., seeking their food in trees, or upon the ground. This family is a very numerous one;

and is subdivided, chiefly according to the form of the bill and

Fig. 263.—Bill of Cockatoo.

tail, into several groups, most of which are well known in this country, by the domesticated specimens which have been introduced into it.—The true *Parrots* have the upper mandible toothed, and longer than it is high; and the tail is short, and even or rounded at the end. They are found in abundance in the tropical forests of both the Old and New World.—In the *Cockatoos*, the bill is higher and curved from the base; the head large and generally crested; the tail lengthened, broad, and rounded.—The *Maccaws* have a long tail, pointed at the end; the upper mandible is very much hooked, so that the tip descends far over the extremity of the lower one; and the lower one is deeper than it is long. They live in flocks in the forests of the New World; and

Fig. 264.—Maccaw.

feed on fruits, maize, &c.—They are represented in the Old World by the *Parrakeets;* of which one group, inhabiting Australia, is formed to live on the ground.—The *Love-Birds* are a beautiful group, consisting of very diminutive species; they are found in both Continents, and are remarkable for having no furcula.—The *Lories* are an Oriental group, having square tails, and dense soft plumage, the colours of which are extremely brilliant; their beaks are comparatively feeble. Some allied species are remarkable for their extensible tongue, furnished with a pencil of filaments at its extremity; by which they are adapted to suck up the nectar of flowers, in the manner of the suctorial birds last described: these are termed *Lorikeets.*—Each species of this numerous family appears to have its own peculiar residence, and a very limited distribution around it; this may be partly accounted for by the shortness of the wings, and the want of powers of flight, which prevent their migrations; but it is partly due also, to the adaptation of each to a peculiar set of conditions, which would not be met with elsewhere. Notwithstanding the differences in their plumage, the various members of this family appear to be formed, as it were, upon one model; and this model differs so widely from that of all other Birds, that many Naturalists have proposed to class the Parrots as an order distinct in itself. They are remarkable for their *educability*, and for the degree of *intelligence* they display; which appears to be superior to that of most, if not all, other Birds. They have, too, more *prehensile* power than the other feathered tribes, and make more use of it; being often seen, when in confinement, to grasp their perch with one foot, and to convey their food to the mouth with the other. Further, although their voice is naturally harsh and unmusical, they can be taught to imitate the sound of the human voice in speaking and singing; in which great assistance is probably given by their thick fleshy tongue, as well as by the complicated structure of their inferior larynx. In their superior prehensile powers, their intelligence, and their arboreal habits, the Parrot tribe seems to hold in the class of Birds a situation analogous to that of the Quadrumana among Mammalia.

423. The family of RAMPHASTIDÆ, or *Toucans*, is distinguished by the very large, light, cellular bill, which is irregularly notched at the edge; and by the peculiar long, feather-like tongue. The beak is used by these Birds for a sort of masti-

FIG. 265.—BILL OF TOUCAN.

cation; the food being crushed between the mandibles in several different directions, before it is swallowed; and being then tossed up into the air, and caught in its descent. The Toucans live on fruit, small birds, and eggs; they may be kept in confinement upon a vegetable diet only; but they show great excitement when a small bird is presented to them. They are only found in tropical America, where they live retired in the deep forests, mostly in small companies. Their flight is straight but laborious; among the branches of trees, however, their movements are easy and active. Their voice is harsh; its only sound resembling the *caw* of a Rook, abruptly terminated.

424. The PICIDÆ, or *Woodpeckers*, have a wedge-shaped bill, with the hard points and the sides compressed near the tip; the tail is usually lengthened and rigid, serving to support the Bird, as in the Creepers; in some species, however, it is short and rounded. They search the trunks and branches of trees, especially those which are decayed, for insects and larvæ; to procure which, they drive off chips from the bark, or dig into the wood. When thus engaged, they cling to the trunk or branch by their strong, curved, and finely-pointed cawls; and support themselves by resting on their stiff tails. When the aperture has been made with the bill, the insect or larva is withdrawn by means of the extensible tongue (§ 343); which is barbed, towards its tip, with small but strong filaments, that act like the teeth of a rake,

and is moistened with a glutinous saliva. These Birds are generally distributed through both Hemispheres; but are most abundant in the warmer regions, though some live on the borders of the frigid zone. Their residence is in the forests, where they live solitarily, avoiding the society of their own species. They nestle in holes dug by themselves in decayed trees; and deposit their eggs at the bottom, usually without interposing anything between them and the wood. Four species are found in Britain, of which one seems to be an occasional visitant. — The family contains numerous other genera, more or less varying in structure and habits from the true Woodpeckers, and distributed over the whole surface of the globe. Some of these live principally on the ground; and feed on ants, &c.—Among them we may mention, as a native of Britain, the *Wryneck*, which has a broad soft tail, instead of a stiff one. Though its plumage is not brilliant, it is one of the most beautiful of British Birds; being of elegant form, and having its colours disposed in a curiously-intricate manner. In its general conformation, it bears a strong resemblance to the Cuckoo; but it agrees with the Woodpecker in the extensibility of the tongue, and in the mode in which it is used for capturing insects. Its name is derived from its curious habit of twisting its neck, with a very odd gesture, when alarmed. Ant-hills are its favourite resort; for these supply it copiously with the food of which it is most fond.

Fig. 266.—Woodpecker.

425. The family Cuculidæ, or *Cuckoo* tribe, consists of a rather extensive series of Birds, for the most part inhabitants of the warmer regions of the globe, and none permanently residing in countries subject to severe winter cold. They have a slightly-arched compressed beak, and a long rounded tail; their wings are usually of moderate length, and they fly with rapidity; their tarsi are short, and their feet rather adapted for

grasping a perch, than for climbing trees. They feed on insects, worms, and soft fruits; in procuring which they glide among the twigs and foliage, leaping from branch to branch, and flitting from one tree to another; when on the ground, however, they walk awkwardly, on account of the shortness of their tarsi. The remarkable instinct of the true *Cuckoos*, of which one species is

Fig. 267.—Grey Cuckoo.

a regular summer visitant in Britain, has been already noticed (§ 351). This Bird seems to be more universally spread over the country, than any other of the migrating species; for it is found not only in open cultivated districts, but in the woods and thickets of upland glens, and on bare rocky hills and bleak moors.—Nearly allied to the Cuckoo, are the *Cowcows* of America, which, like our own race, derive their names from their peculiar notes. Their general habits are the same; but they build nests for themselves, and do not intrude upon others. To this family also belong the *Indicators* or *Honey-guides* of Africa; which are celebrated for their curious habit of guiding the natives to the nests of the wild Bees, enticing them to the spot by flitting before them, and reiterating a peculiar cry They have short, strong, and rather conical bills, resembling those of the Sparrow. Their skin is very tough, and protects them from the stings of Bees; but these sometimes kill them by attacking their eyes.

Order IV.—RASORES.

426. The Birds of this order are for the most part adapted to a kind of life entirely different from the preceding; being destined to obtain their subsistence from the vegetable world, and to pass their time upon the ground, rather than among trees, or upon the wing. Their food chiefly consists of grains and seeds; to obtain this they are furnished with short, blunt, and robust nails, the use of which has obtained for them the appellation of *Rasores*, or *Scratchers*. Their bodies are for the most part bulky, and their legs strong; their powers of flight are inconsiderable, their wings not being of a size proportionate to their bulk; but their legs are sufficiently long to enable them to walk with facility upon the ground. The beak is usually arched; and surrounded at the base with a soft skin, in

Fig. 268.—Nepal horned Tragopan.

which the nostrils are pierced. To meet the difficulty which attends the reduction of their food, they are provided with a large crop and a powerful muscular gizzard (Fig. 201); by the action of which it is prepared for the digestive process. The nests of these Birds are rudely constructed; and are usually situated on the ground. Instead of associating in

pairs. they are polygamous,—that is, each male is surrounded by several females. The male takes no part in the construction of the nest, or in the nurture of the young; and these are hatched with their eyes open, and with their bodies covered with soft downy feathers, and are generally able to walk about in search of their own food, as soon as they leave the shell. The Birds of this order are for the most part domesticable; but they show a low degree of intelligence. Of all the feathered tribes, they are the most useful to Man; affording him a large quantity of wholesome and delicate food. In their domesticated state they multiply with great rapidity, if kept well supplied with nourishment. The plumage of the males is generally gay, and often possesses a degree of brilliancy rivalling that of the most splendid among the Perchers; they are frequently distinguished, also, by possessing crests, or other ornamental appendages to the head. The females, however, are of much more sober aspect.

427. There are many interesting analogies between the Rasorial Birds, and the Ruminant tribes among Mammalia. In the first place, the food of both is vegetable; and in both there is a peculiar provision for moistening it and reducing it, before it is submitted to the true digestive process. The *crop* of the Fowl is strictly analogous to the *paunch* of the Sheep; both being mere dilatations of the œsophagus, to receive the food as fast as it is swallowed, and to retain it whilst it is being thoroughly saturated with fluid. Again, these tribes correspond in their low degree of intelligence, and in the facility with which they are brought under subjection to Man; we find in them by far the greater number of the domesticated species, in their respective classes. Further, they are alike in regard to the bulk of their bodies, and the degree in which this may be increased by an extra supply of food. They resemble each other, also, in the tendency to variation which they exhibit, under the influence of varieties in external circumstances; giving origin to numerous different *breeds*. And, lastly, they correspond in the possession, by the males, of appendages to the head; which are rarely possessed by Birds or Quadrupeds of other orders.

428. The family of COLUMBIDÆ, or *Pigeons*, differs in many

respects from the general type of the Rasores, and approaches to the Perching Birds.* The bill is formed upon the plan of that of the Gallinaceæ; but the wings, feet, and tail more resemble those of the Insessores; and they live more among trees than upon the ground. They associate invariably in pairs; their nests are constructed in trees, or in the holes of rocks; and both parents sit upon the eggs. The Pigeons are also remarkable for the peculiar mode in which the young are fed. The crop, instead of being an expansion of the œsophagus on the right side only, as in other Birds, is double; and its walls are furnished with numerous glands, which become developed in both sexes during the period of incubation. These glands secrete a sort of milky substance, with which the food that passes into the crop is moistened; and the food, saturated with this secretion, is disgorged by the parents for the nourishment of their young. In Fig. 269 is represented the double craw of the Pigeon; one side (*a*) exhibiting its usual aspect, and the other side (*b*) showing its appearance in Pigeons which have newly-hatched young.—The true *Pigeons* are found in most parts of the World; and in some they multiply to an enormous extent. In Britain there are four native species: the *Ring-Dove*, *Cushat*, or *Wood-Pigeon*, which is the largest of these; the *Rock-Pigeon*, which is the original of all our domesticated breeds; the *Stock-Dove*, which, like the Ring-Dove, chiefly frequents coppices and groves; and the *Turtle-Dove*, which is the smallest, the most elegantly formed, and the most beautifully coloured. Among the Pigeons of other

Fig. 269.—Pigeon's Craw.

* It is now generally regarded as forming a distinct order, that of the Columbæ, intermediate between the Rasorial and Perching Birds.

countries, there are none more remarkable than the *Passenger-Pigeons* of North America; the multiplication of which is so rapid, and their destructive power so great, that they are obliged to migrate from place to place in vast flocks, to obtain their food. These flocks are often so extensive, that they occupy three hours in passing any given spot; and as the Birds fly with great rapidity and steadiness, their rate is probably not less than sixty miles an hour; from which the length of a single flock must be 180 miles. It has been calculated by M. Audubon, that the number of individuals in one of these enormous flocks, estimating its breadth at a mile, and allowing two Pigeons to each square yard (which is rather within than beyond the mark), amounts to 1115 *millions;* and that as each Pigeon daily consumes fully half a pint of food, the quantity necessary for supplying this multitude must be 8,712,000 bushels per day. When it is stated, also, that great numbers of such flocks often follow one another, darkening the air for several days in succession, the wonder is, not that they should do great injury to the agriculturist, and should be dreaded by him as a pest, but that they should anywhere find a sufficient supply of nutriment. Their breeding-places are described as large forest-tracts, fifty miles in length, by four or five in breadth; in which every tree is occupied by from fifty to a hundred nests.—Allied to the true Pigeons on one side, but presenting more points of resemblance to the Insessores, are the *Tree-Pigeons* of Asia, Africa, and Australia; they have long wings, and live among trees, feeding on fruits and berries. And, on the other side are the *Ground-Doves*, which have short rounded wings, and which are mostly seen on the ground seeking for grains and seeds; these are inhabitants of both hemispheres.

429. To this group also the recent researches of Naturalists have led them to refer a curious bird which, although living within the last two hundred years, has now been so completely extirpated from the face of the earth, that our only knowledge of its external appearance is derived from a few pictures, and of its zoological characters from a few fragments preserved in two or three museums. This is the *Dodo* (Fig. 270), which was very

abundant in the Mauritius at the first discovery of that island in 1598, but was entirely destroyed in the course of the seventeenth

FIG. 270.—DODO.

century by the crews of the East India ships, who found its flesh exceedingly palatable after a long course of salt diet. It was a large Bird, larger than a Swan, with short, strong legs, and rudimentary wings. This latter character led to its being, until very recently, arranged with the Cursorial Birds (Ostriches, &c.). The Dodo was also found in the Isle of Bourbon; and from some bones in the possession of the Zoological Society, it also appears to have existed in Rodriguez. This little island was the home of two allied species; one of which was described by the French voyagers under the name of the *Solitaire.*

430. The proper *Gallinaceous* Birds are divided into six families; the CRACIDÆ, or *Curassow-Birds;* the PHASIANIDÆ, or *Pheasants;* the TETRAONIDÆ, or *Grouse;* the CHIONIDÆ, or *Sheath-bills;* the TINAMIDÆ, or *Tinamous;* and the MEGAPODIDÆ, or *Megapodes.*

431. The family of CRACIDÆ, or *Curassows,* is peculiar to tropical America, living in the woods, building in trees, and

easily tamed. Many of them approach the Turkey in magnitude; and their flesh in delicacy and whiteness surpasses that of the Fowl or Pheasant. They feed on berries and on various sorts of game. In many parts of South America, these Birds have been long domesticated; and there is no doubt that they might be profitably introduced into Europe, since it has been proved that they readily become habituated to its climate, and that they thrive as well, and breed as rapidly, in confinement, as do ordinary Poultry. The *Crested Curassow* is one of the most common Birds of Guiana; living in the forests, and on the borders of the cultivated tracts; and building its nest on trees. It congregates in large troops; and is extremely unsuspicious of danger, except when it has been frequently molested. This species has been bred in Holland; and is common in a domestic state in Berbice, Essequibo, and elsewhere; it requires little care, but needs plenty of room, a dry soil and sheltered situation, and trees on which to perch. It is found also in Mexico and Brazil,—its range being thus very extensive.

Fig. 271.—Crested Curassow.

432. In the family Phasianidæ, or *Pheasant* tribe, the hind toe is placed higher on the tarsus than the front ones, so that only the tip touches the ground; and the tarsus of the male is generally furnished with one or more *spurs* (Fig. 272). This group includes, with the Common Fowls, the Peacocks, Pheasants, Turkeys, Partridges, &c., of various parts of the world; all of which agree in these characters, and in their general mode of life. The native country of the true *Fowls* appears to be India, in the jungles of which these Birds abound, their food consisting of grain, seeds, &c. They are characterised by the

arching of the tail, and its lateral compression, and by the presence of wattles on the sides of the head. Of all domestic

Fig. 272.—Foot of Common Fowl.

Birds, the Common Fowl seems to have been the earliest reclaimed, and is the most extensively spread. It has now branched out into numerous varieties or breeds, many of them differing considerably from each other; thus one is destitute of tail, another has the comb replaced by a tuft of feathers, another has five toes on each foot, and the Bantam variety has the tarsi feathered down to the toes. The Bankiva Jungle Fowl is probably the species whence they were derived, this being found to breed freely with the domesticated races. The period at which it was introduced into our island is completely uncertain; but we know that it must have been very remote. The ancient Greeks and Romans valued it for its pugnacity; and frequently engraved its figure on their medals. The taste for Cock-fighting has prevailed, not merely among the ancients, but among several modern nations; the Chinese, the Sumatrans, and the Mussulman natives of India, are devoted to the sport,—if such it may be called; and in our own country, it has long ranked amongst the amusements of the people. The diffusion of intellectual knowledge, however, combined with the elevation in the popular

tastes, is now rapidly putting an end to the practice in this country.—The *Pheasants* are nearly allied to the Fowls; but they have the tail more lengthened, with narrow and pointed tail-feathers; and the neck is usually deficient in wattles. They are found wild in various parts of Asia, where many very splendid species exist,—amongst them the *Argus* (Fig. 272), a native of Sumatra, Malacca, and the south-east of Asia, which

Fig. 272.—Argus Pheasant.

is so named from the numerous eye-like spots on its feathers. This beautiful Bird is little inferior to a Peacock in size, and the middle tail-feathers of the male often exceed four feet in length; it is remarkable for the elongation and breadth of the secondary quill-feathers, which spread boldly out at their extremities, and form, when the wings are opened, a sweeping, fan-like plume.—The *Tragopans* (Fig. 268) seem to connect the Pheasants with the Turkeys, being provided with large wattles, which are characteristic of the latter. They are inhabitants of the countries forming the northern border of India, and are very splendidly coloured.—The *Turkeys* have a short and rounded tail, and the head and neck bare of feathers. The

wattles, which are larger in them than in any other birds of this family, are loose flaps of skin, copiously supplied with blood-vessels, and capable of being contracted or dilated at pleasure; they are greatly affected by the emotions of the animal, becoming distended, and of a heightened colour, under the influence of fear or anger,—probably in the same manner as the cheeks of Man are reddened by the blush of shame or the excitement of rage. Turkeys are natives of the forests of North and Central America, where they feed on grain and other vegetable substances; and their introduction into Europe, therefore, has been of comparatively recent date.—The *Peacocks* are distinguished by the great length of the tail coverts, and by the peculiar arrangement of the numerous feathers, which enables the bird to spread them out into a complete circle at will. They are inhabitants of Asia, where they inhabit the woods and jungles, feeding on grain, buds, &c.

433. The family of TETRAONIDÆ, or *Grouse*, may be regarded as representing the preceding group in the northern parts of Europe, Asia, and America, to which it is nearly restricted. It has many characteristics in common with it; but the wings are generally long and acute, and the legs more or less covered with feathers. The *Grouse*, of which only a single species—the *Black-Cock*—now exists in Britain, but of which there are several on the Continent of Europe, are generally strong heavy Birds, varying in size from that of a Turkey to that of a common Pigeon. They live upon various kinds of vegetable substances; such as the soft shoots and leaves of trees and shrubs, grasses, berries, and seeds. Although they generally gather their food on the ground, some of them betake themselves to trees for that purpose, and many occasionally perch. In their movements they closely resemble the Partridges; but they frequent different localities, preferring low, damp, grassy, or ferny places, in the neighbourhood of woods or thickets; and are more shy and wary in their habits.—Besides the Black Grouse, another species, known as the *Cock of the Woods*, or *Capercailzie*, was formerly abundant in Scotland. Having been extirpated for the last half century by the indiscriminate zeal of sportsmen, and by the

destruction of the forests it inhabited, many attempts have been made to re-naturalize it, by introducing individuals from Norway; in the mountainous parts of which country it is still plentiful. This species is of considerable size, being not much inferior to the Turkey in bulk, and more robust in proportion. Its food consists of the leaves and buds of the fir tribe, together with juniper-berries, cranberries, &c.; the young are fed at first with insects, and especially with the larvæ of ants. This fine Bird is often domesticated in Sweden, and will breed in confinement.—The *Ptarmigans* are nearly allied to the Grouse, but are destined to inhabit still colder regions. They frequent the open heaths and hill-sides of the northern parts of the temperate zone; and one species, the Grey Ptarmigan, is only found near the summits of the loftier hills. The chief peculiarity in their structure consists in the covering of their legs and toes with thick hair-like feathers, down to the very claws; and this covering becomes so thick and deep in winter, as to give to the leg the appearance of a Hare's foot,—from which the scientific name of the genus, *Lagopus*, is derived. The base of the beak, also, is covered with closely-set feathers; and these increase in the colder season, until little more than the point of the bill is visible. Their food consists of mountain-berries and heath-shoots in summer; and of buds and leaves in winter; and at the latter season, the Birds are often obliged to burrow under the snow for food and shelter. Two species are inhabitants of Britain; the *Brown Ptarmigan*, or Moor-Fowl, commonly termed the *Red Grouse*, which is common on the high moorland districts of the northern counties of England, Wales, Scotland, and Ireland;—and the *Grey Ptarmigan*, sometimes called the Alpine Partridge. It is in this last species that the adaptation to a residence among bleak and snow-clad hills is best seen. Its mingled grey and brown summer livery blends so well with the hues of weather-stained and lichen-tinted rocks, that a whole covey of them may be easily passed without being noticed; and towards winter, the colour of the plumage gradually disappears, until it becomes of a pure white, not distinguishable from snow.—The *Sand-Grouse* are distinguished by their long pointed wings, and by the conical

form of their tails; their bills are short and highly arched. They are natives of the sandy plains and rocky deserts of Africa, Asia, and the southern districts of Europe. They are Birds of powerful and rapid flight, and love to wander from place to place, sweeping over the hot and arid solitudes in which they find a congenial abode. Though they repair in large flocks to localities in which they can obtain water, they are not truly gregarious, but disperse themselves in pairs over their feeding grounds. They are so abundant in some districts, that when they rise on the wing, they seem at a distance like large clouds.—The *Partridges* and *Quails*, unlike the other birds of this family, frequent the neighbourhood of Man, resorting for their food to cultivated grounds, and finding shelter in the enclosed fields. They run with great speed; and have a strong, steady, uniform flight, performed by regular beats of the wings, and producing a whirring sound; but they generally prefer skulking, to avoid danger. They nestle on the ground, and bear a numerous progeny; seldom breeding, however, more than once in a season. Two species of Partridges, the *Common* and the *Guernsey Partridge*, are found in this country, which is also visited in the summer by the *Common Quail*. In North America their place is taken by some allied birds, forming the genus *Ortyx*, in which the lower mandible has two teeth on each side near the point.

FIG. 274.—GREY PTARMIGAN.

434. The CHIONIDÆ, or *Sheath-bills*, resemble the Grouse, but have the nostrils surrounded by a kind of sheath. They are inhabitants of the southern hemisphere, where they represent the Tetraonidæ of the northern. Some of them bear a strong resemblance to the Snipes, Plovers, and Sand-pipers among the Waders; and the Sheath-bill of the Southern Ocean frequents the shores, feeding on sea-weed and mollusks, and sometimes

venturing far out to sea,—whence it has been placed by some Naturalists among the Natatores.

435. The family of TINAMIDÆ, or *Tinamous*, is peculiar to the warmer parts of the world. The Birds which it includes are intermediate in form between the Phasianidæ and the Bustards; having the long neck and legs, and the small feet, of the latter, and a naked scale covering the nostrils, as in the former. The tail is nearly altogether wanting, and the wings are short; the hind toe is not at all developed, or has the form of a mere claw. These Birds are mostly found among the low brushwood or tall grass; and their food consists of fruits and insects.

436. The family of MEGAPODIDÆ, or *Megapodes*, is peculiar to Australia and the adjacent islands. It derives its name from the large size of the feet of the Birds included in it; which are furnished with long blunt claws. One species (*Talegalla Lathami*) is termed by the colonists the Brush Turkey, on account of the wattles with which its neck is furnished; it is a large handsome bird, inhabiting brushwood, and feeding on seeds, berries, and insects. Its flesh is delicate and tender: and it is capable of domestication. Another species (*Leipoa ocellata*), in which the head is clothed with feathers, and crested, is known as the Native Pheasant; it is more slender and elegantly formed than the last, and inhabits rather the sandy plains, feeding chiefly upon seeds and berries. In the genus *Megapodius*, the form of the beak and the general aspect strongly resemble that of the Fowl; whence the name Jungle-Fowl is commonly given to it. The head is crested; and the toes and claws are of great size and strength.—These Birds, therefore, may be regarded as representing in Australia the different sections of the family Phasianidæ, which are wanting in that division of the globe. They are all remarkable for the very curious mode in which their eggs are hatched; this will be described in the succeeding volume.

Order V.—CURSORES.

437. In the Birds of this order, we have a marked exception to the general type of the class. We are accustomed to think of Birds as denizens of the air,—as endowed with the powers of flight; but the Ostrich and its allies, of which this order consists, are exclusively terrestrial. They have wings, it is true; but these organs are but little developed, and are totally incapable by their most energetic action, of raising the Birds from the ground. The utmost that they can accomplish, is to assist the powerful *run*, which is effected by the strong and highly-developed legs. The whole locomotive energy is thrown into the posterior extremities, the bones of which are large and stout, and the muscles acting upon them exceedingly voluminous. These Birds all agree in the flatness of the sternum, which is entirely destitute of projecting keel (Fig. 275); and the pec-

Fig. 275.—Sternum of Emeu.

toral muscles which arise from it are extremely thin. In many points of their conformation they approach Mammalia; thus we find in the Ostrich a partial diaphragm, which is still more completely developed in the Apteryx; and the ureters meet in a sort of urinary bladder, instead of emptying themselves at once into the cloaca (§ 346). It is not only in the

absence of wings, but in the character of the plumage, that the want of adaptation of these Birds to flight in the air is manifested. For, as already stated (§ 325), the barbs of the feathers have so little adhesion to each other, that the air can pass readily between them; and in some species they are at such a distance from each other, as to give the whole feather the appearance of a stout branching hair. All these birds construct their nests upon the ground; and in several species it appears that numerous females lay in the same nest; the eggs, to the number of thirty, or even more, being chiefly tended by the male.

438. As in most other very aberrant groups, the number of species contained in this order is small; but they differ considerably from each other in form and structure, especially as regards the beak and feet. Formerly, when the *Dodo* was still placed amongst these birds, the heterogeneous composition of the order was still more striking.—As at present constituted, all its members but two have a broad and depressed beak and legs of considerable length,—these form the family of the STRUTHIONIDÆ, or *Ostriches*, including the *Ostrich*, properly so called, which has only two toes; and the *Rhea*, or American Ostrich, the *Cassowary*, and the *Emeu*, which have three toes all turned forwards. In the curious *Apteryx* of New Zealand, of which two species are now known, the bill is elongated, slender, and curved, with the *nostrils placed at its tip*; and the feet are furnished with a short hind toe. These singular birds form the family APTERYGIDÆ. Besides these, the remains of several allied species of gigantic Birds have been found in New Zealand and Madagascar.

439. In the *Ostrich* the wings are sufficiently developed to accelerate the speed of the Bird, when running along the plains it frequents; although the plumage is lax and flexible. The *African Ostrich*, which has been known from remote antiquity, is the tallest of all Birds at present known to exist; it attains the height of six feet and a half, or even eight feet; and is chiefly distinguished by the presence of only two toes upon each foot, one of them being much larger than the other (Fig. 185). It inhabits the sandy deserts of Arabia and Africa, everywhere

avoiding the presence of Man, but not disliking the society of other animals. Flocks of Ostriches are not unfrequently seen on the Great Karroo of South Africa, in company with troops of Quaggas, all amicably feeding together, and when alarmed scouring the desert with extraordinary rapidity. The Ostrich is, indeed, one of the swiftest, if not the most rapid, of all *running* animals. When darting along in a straight line, it leaves the swiftest Horse far behind; and can maintain its speed for several hours. Hence it can only be captured by a number of horsemen, taking different sides of the plain, or by darting across the path of the bird. When driven to extremities, it will occasionally turn with fury on its pursuers, and will inflict dreadful wounds with its claw. The Ostrich has been domesticated, and behaves in this state with much gentleness to those with whom it is familiar, though fierce and violent towards strangers. It will permit itself to be mounted, even by two full-grown men, and carries them with great ease. Its food consists of the tops of shrubby plants, seeds, and grain; but it will swallow many other substances with indiscriminating voracity, such as stones, sticks, pieces of metal, cord, leather, &c. It is probably guided by the same instinct in swallowing hard substances, that leads the Fowl to swallow gravel; for they are probably of use in assisting the action of the gizzard in the reduction of the food. The curious habits of this Bird in regard to the incubation of its eggs will be hereafter detailed.—The *Rhea*, or American Ostrich, is a smaller Bird, more completely feathered on the head and neck;

Fig. 276.—African Ostrich.

the wings are rather more developed than in the African species and are terminated by a hooked spur; and the feet possess three toes, armed with stout claws, the central one being much the largest. Two species are now known; the *Nandu*, which stands about five feet high; and *Darwin's Rhea*, which is much smaller. Both these species are partly aquatic in their habits; the former is chiefly found upon the plains bordering the river La Plata, extending through the South of Brazil to the North of Patagonia; whilst the latter takes its place in Southern Patagonia.

440. The *Cassowary* is a native of Java and the adjacent islands of the Indian Archipelago; it is much inferior in size to the Ostrich, its height when erect being about five feet; but it is robustly built, and very strong. In many important points of internal structure, it differs from the Ostrich; particularly in the conformation of its digestive organs, which are not adapted for hard coarse diet, but for eggs, fruits, and tender succulent herbage. It is not common even in its native islands; but is sometimes kept tame there. The head is surmounted by a sort of crest or helmet, which is supported by a bony growth resembling that of the Hornbills (§ 397); and, as in that group, the appendage is not developed in the young Bird. The skin of the head and neck is naked, and coloured blue, purple, and scarlet, blended together; and the lower part of the neck is furnished with a pair of wattles. The pinions are very small, and are concealed between the plumage; they bear, instead of feathers, five cylindrical stalks without any barbs.—The *Emeu*, a native

FIG. 277.—CASSOWARY.

of New Holland, and of the neighbouring islands, is nearly allied to the Cassowary; but differs from it in the form of the

Fig. 278.—Emeu.

bill, and has no helmet. It nearly equals the Ostrich in bulk; but is lower on the legs, shorter in the neck, and more thick-set in the body. In its native regions, it is said to stand six or seven feet high, when its head is fully elevated. The wings are mere rudiments, destitute of plumes, and hidden beneath the feathers of the body; the cheeks and throat are nearly naked. The feathers bear a strong resemblance to branching hairs; the laminæ of the vanes being placed at a distance from each other. Two stems arise from each root; one of these may be regarded as an increased development of the *accessory plume*, a sort of little tuft which grows at the base of ordinary feathers. The Emeu feeds upon leaves, fruits, and herbage; for the plucking of which, its strong straight beak, rounded at the point, is well adapted. It is a timid and peaceful bird, trusting to its speed for safety, except when hard-pressed; it then strikes violently with its legs. The flesh of the young is extremely delicate; but

that of the full-grown Bird is coarse. It is pursued, however, for the oil that is obtained from it; of which the skin produces six or seven quarts. The eggs are highly esteemed as food. Though not an aquatic bird, the Emeu swims well, and has been seen to cross rivers. There is good reason to believe that it might be easily naturalized in Europe; as it not only thrives, but breeds, in captivity; and seems to be quite capable of adapting itself to the climate of England.

441. Of all the Cursores, the *Apteryx* of New Zealand appears to be the one which is most completely destitute of

Fig. 279.—Apteryx.

wings, and which departs most widely from the general type of the class of Birds. Its wings are trifling rudiments, buried beneath the general plumage of the body, and not to be discovered without difficulty; they are each terminated by a hooked claw. The beak is long, slender, and slightly arched, resembling that of the Curlew. The nostrils are not situated near the base of the bill, as in most other Birds; but are minute narrow fissures, one on either side of its tip. The legs are extremely powerful, and the tarsi thick and short; the toes are three anteriorly and one posteriorly,—the former robust and armed with strong claws, well adapted for digging,—the latter a thick sharp horny spur, which is used as a weapon of offence and defence. There is no vestige of a tail. This extraordinary Bird is principally found in the southern parts of the middle island of New Zealand; especially frequenting fern-brakes; and seeking shelter in clefts of rocks, hollow trees, or in deep holes

which it excavates in the ground.. These holes are its breeding places, and conduct to a deep chamber in which the Bird deposits its eggs upon a bed of fern. The food of the Apteryx consists of insects and particularly of worms; the latter it procures by thrusting its bill into the soil, when soft, and drawing them forth; or by striking with its bill and feet on the ground, when it is hard, so as to disturb the worms, which it seizes as soon as they make their appearance. Its habits are nocturnal; and the natives hunt it by torchlight for the sake of its skin, which is much valued by them, as a material for the chiefs' dresses. When it is pursued, it elevates its head like an Ostrich, and runs with great swiftness; and if overtaken, it defends itself with great spirit and vigour, and inflicts dangerous blows with its spur-armed feet. This remarkable Bird seems likely to be soon exterminated from the very limited portion of the globe which it inhabits at present; and must then be numbered among the races that *have been*.

442. But if this be the probable fate of the *Apteryx*, it is one which has already befallen numerous species of Birds which formerly inhabited the country in which it is still to be found. In the volcanic sands of New Zealand the bones of several birds considered to be allied to the Ostriches have been found, and described under the generic name of *Dinornis*, first proposed by Professor Owen. One of these (the *Dinornis giganteus*) is supposed to have been at least fourteen feet in height, and some of the others were also of large size. The egg of one of these Birds, discovered in a fossil state by Mr. Walter Mantell, is described by him as being so large that his hat would just serve as an egg-cup for it. The traditions of the natives refer to the existence of gigantic Birds in the island at some distant period; to these they give the name of *Moa*, and they have even pointed out the spot in which the last of these Birds was killed after a terrific combat, in which several of its assailants were also destroyed. From this, and from the semi-fossil state of the bones, it appears pretty certain that these birds existed in New Zealand since it received its human population; and it has been suggested by Professor Owen that when the islands were first colonised by

a party of Malays, driven thither in a storm (which was probably the mode in which human beings first found their way thither), these birds were eagerly sought, as being the only large animals that could serve as food; and that by being improvidently destroyed, the whole race was soon extirpated. The remains of some large birds allied to the *Apteryx* have also been discovered in New Zealand; they have been described under the name of *Palapteryx* by Professor Owen. Within the last few years the eggs and a few bones of a Bird supposed to be as large as the *Dinornis* have been found in Madagascar. The largest of the eggs measured upwards of a foot in length, or twice as much as that of the Ostrich. The bird has been described under the name of *Æpyornis*.

Order VI.—GRALLATORES.

443. The scientific name of this order, which literally means *stilt-walkers*, is, on the whole, more appropriate than the term *Waders*, which is commonly applied to it. For all the Birds which it includes are remarkable for the length of their legs, and especially of the shank; whilst many can scarcely be said to be aquatic in their habits. The length of the lower part of the leg, and the absence of feathers at the lower end of the tibia, enable them to wade into water of a certain depth, without wetting their plumage; and thus to procure fish, mollusks, aquatic worms and insects, &c., by means of their bills, which are usually supported upon necks of a length proportional to that of their legs. They are for the most part slender in form; and thus present a marked contrast with the robust bodies of the two preceding orders. The wings of these Birds are usually long, and adapted for rapid flight. The tail, however, is short; and when flying, the Birds stretch out their long legs behind, to counterbalance their long necks, and to serve as a rudder. They are very generally diffused over the globe; and many of them make periodical migrations of considerable length. They generally construct their nests upon the ground, concealing them among

the herbage; and the young are usually able to run about as soon as they are hatched. Considerable varieties of structure present themselves in this order; some of the birds which it contains having a strong resemblance to the Gallinaceous and Ostrich tribes; whilst others have a close relationship with the strictly aquatic Birds of the next order. They may be arranged under the following families:—OTIDÆ, or *Bustards;* CHARADRIADÆ, or *Plovers;* GRUIDÆ, or *Cranes;* ARDEIDÆ, or *Herons;* SCOLOPACIDÆ, or *Snipes;* and RALLIDÆ, or *Rails.* Of these, the Bustards and Cranes are the least aquatic in their habits; and the Rails the most so.

444. The OTIDÆ, or *Bustards*, which are peculiar to the Eastern Hemisphere and to Australia, have the stout body, strong limbs, long neck and legs, and small feet, of the Ostrich; but the wings are longer. The beak is short, conical, and compressed. They have three short toes united at the base, but no hind toe. They frequent wide plains, extensive downs, and open lands dotted with patches of shrubby vegetation; and their food consists of tender herbage, grain, and insects. They run with extreme rapidity; and, unless closely pursued, they seldom take wing; when obliged to rise, however, their flight is direct and rapid. They are shy and watchful; and not to be approached without difficulty. Like the Gallinaceæ, they are polygamous in their habits; and the eggs are deposited on the ground, without any proper nest. There is a remarkable difference in the size of the male and female Bustards; the latter being, in some species, not above a third of the bulk of the former. The males are further distinguished by a gayer plumage; but this is lost in winter. The *Great Bustard* is the largest of all the native Birds, not only of Great Britain, but of Europe. The male, when full grown, is four feet in length, and not less than nine in the expanse of its wings; its weight is from thirty to forty pounds. This noble Bird was once common in our island; but it is now rarely to be seen, except in the western part of Norfolk. It is still common, however, in Spain, and the plains of Greece, in some parts of Russia, and on the wilds of Tartary. It was formerly stated that the male Bustard had a membranous pouch

under the skin of the neck, capable of holding seven pints of water, and communicating with the mouth by an opening under the tongue. This, however, has lately been found to be an error, as no such structure exists in the Bustard. The *Little Bustard*, which also is a native of Britain (though now, like the preceding, a rare Bird), is not above one-third of the dimensions of the preceding; and its wings are shorter in proportion. Other species of Bustards are found in Africa and India; some of them closely allied to those just described; whilst others partake of the characters of the next family.

445. In the comprehensive family of CHARADRIADÆ, or *Plovers*, the legs are long, the toes short, the hinder one small or altogether wanting (Fig. 207), and the wings long and powerful. The bill is short, and arched towards the tip; its covering is soft at the base, but hard at the extremity. These Birds chiefly frequent sandy unsheltered shores, and exposed commons or moors. They congregate in flocks, and run with great swiftness; many of them are nocturnal in their habits. They belong, for the most part, to the Old World; and are abundant in temperate climates. Of the true Plovers, we have a good example in the *Golden Plover*, which is a Bird of Passage, spread over Europe, Western Asia, and portions of North Africa. It breeds in various parts of the British Isles; but it is only found in the southern districts during the winter, at which time its numbers are much increased by arrivals from northern latitudes. As in the Bustards, the winter livery differs considerably from the summer; being lighter in tint, and less varied. The flight of this species is rapid and vigorous, and, during the spring and summer, is usually at a greater elevation; and the Bird is frequently seen in the air performing the most graceful evolutions as it sails round and round. It takes its repose during the day; and goes forth at night in search of its food, which consists of insects, larvæ, slugs, worms, &c. For these it frequents fallow lands in the autumn, and then becomes very fat; in which state it is much esteemed as a luxury for the table. The Plover associates in pairs during the breeding season; but at other times indiscriminately in large flocks. The eggs are usually deposited in the neighbourhood of

marshes or streams, under cover of the herbage. The common English name *plover*, seems to be a corruption of the French *pluvier*, or Rain-Bird; its activity being the greatest when the weather is damp.—The *Dotterel* is a smaller species, which breeds in colder latitudes than ours, and winters in warmer,—passing over Britain in large flocks, in its spring and autumn migrations. It occasionally breeds on the mountains of the northern parts of our island. The Dotterel has been accused of excessive stupidity, and its name has even become proverbial on this account, in the parts of Britain where it is best known; there appears no other reason for this, however, than, that being fresh from wilds untrodden by Man, and not having experienced persecution, it does not so readily take alarm, as do Birds that have lived in nearer neighbourhoods to their great enemy.—The *Grey Plover* is another species which visits our island in its migrations. Its summer residence and breeding place is within the arctic regions; but it retires to the countries of Central and Southern Europe, to pass the winter. Another species of Plover is found in the northern and temperate parts of Asia and North America.

446. The *Lapwings* are nearly allied to the Plover; but they have the hind-toe more developed; and the head is ornamented either with a crest, or with fleshy wattles and protuberances about the base of the beak. They frequent open grounds and plains, especially where the soil is moist; and they feed on insects, worms, larvæ, &c. The name is derived from the artifices employed by the Parent-Birds to decoy away intruders from their nests; for they will place themselves almost within reach of their enemies, feigning lameness, and fluttering and tumbling in the path before them, until they have drawn them to a sufficient distance; after which they will take wing and escape. The Lapwing, or Peewit (so called from its note), of this country is a very beautiful Bird; and has an elegant crest of long slender black feathers arising from its head. Between the spring and autumn, it frequents [illegible] and tracts in various parts of Britain; but as winter approaches, it assembles in vast flocks, which betake themselves to the districts near the sea and

the mouths of rivers, especially in the southern part of our island.—The *Turnstones* have a short bill, thick at the base, and narrowing gradually to the point; and with this they turn over the stones on the sea-shore, in quest of the small molluscous and crustaceous animals on which they feed. The species which visits our shores is very universally diffused; being met with in almost every part both of the northern and southern hemispheres. It breeds in high latitudes, and migrates towards the tropics for the winter season.—Another curious Bird of this group is the *Oyster-Catcher;* the bill of which is long, hard, and compressed towards its point, which is abrupt and chisel-like. With this instrument it opens the shells of bivalve mollusks, such as mussels, oysters, &c.; and detaches limpets from the rock. It wades in quest of its food amongst the shallows; and swims where the depth forbids wading. This Bird is distributed over the whole of the European Continent, and a great part of Asia and Africa, frequenting chiefly the low flat coasts, and laying its eggs on the bare ground amidst the shingle, or such herbage as grows above high-water mark.

447. In the family GRUIDÆ, or *Cranes*, the hind toe is rather short; and is much higher on the legs than the front ones. The beak is strong, hard, and rather long. The wings are rounded; and the tertiary feathers elongated into drooping plumes. Instead of deriving their sole subsistence from the worms, insects, &c., of lakes and morasses, the members of this family live in great measure on vegetable food; and frequent plains and newly-sown fields, and cultivated districts. —The *Common Crane* (Fig. 280) is an inhabitant of a large portion of Europe, Asia, and [illegible]; it was formerly a regular visitor to our island, but seems to have been driven away by the advance of cul-

FIG. 280.—CRANE.

tivation, which has deprived it of many of its most congenial localities. Its breeding places are in the north of Europe and Asia; but in its winter migrations it visits India, Egypt, and other parts of Africa. Its aërial voyages are performed at a great height in the air; and its cries may be heard, when it is itself beyond the limits of the sight.—The *Demoiselle*, or *Numidian Crane*, is remarkable for the grace and symmetry of its form, and the elegance of its deportment. It has a beautiful drooping head-crest of soft loose plumes, which undulate with every movement.—In America we find a curious species, the *Trumpeter*, which is remarkable for its loud harsh voice, and for the attachment it displays to Man, in a domesticated state. It equals a large fowl in bulk, but has much longer legs and neck; it is a native of the forests of tropical America and the wild uplands, never visiting fens or the borders of lakes or rivers. It walks and runs with great celerity, but seldom takes wing, and rises in flight but a few feet from the ground. The name of this Bird is derived from the hollow internal sound, which it makes without opening the bill; this seems to be produced by the passage of the air from the lungs, into two large membranous bags, which are given off from the windpipe just as it enters the chest.

448. The family ARDEIDÆ, or *Heron* tribe, may probably be regarded as the typical group of the order; the Birds which it contains being pre-eminently formed for wading. They frequent, as a rule, the margins of rivers, lakes, or marshes; and feed on Fish, Reptiles, and even small Mammalia. The beak is usually long, of considerable strength, and sharp-pointed. The toes are generally elongated, and the hind toe upon the level of the rest, so as to form a more extensive bearing to the foot. The wings are large, and their flight easy; and many of the species are adorned with elegant plumes and crests (Fig. 281). They usually build and breed in society; but wander alone in search of food, and separate when the breeding season is over. Many subordinate groups, differing considerably from one another, are contained in this family; of these we shall briefly notice the chief. —The *Common Heron* is spread over the greater part of the Old World; and is represented by an allied species in America.

In our island, and in temperate climates, it is stationary during the whole year; but it is migratory in colder latitudes. It feeds chiefly upon fish; which it catches by means of a sudden dart of its long beak. Contrary to the usual habit of this order, the Heron builds its nest in the highest trees of the neighbourhood it frequents. The young remain in the nest for five or six weeks, and are supplied with fish by the parents.—The *Bittern* is nearly allied to the Heron, but it is of smaller size. It frequents wild morasses and the oozy banks of large rivers, where it crouches among flags, reeds, and bulrushes. Here, too, the nest is placed, on some slight elevation; but never in trees.

Fig. 281.—Crested Heron.

This Bird is remarkable for the "booming" sound which it utters during the breeding season; at other times its cry is different. When attacked, it defends itself with great resolution by means of its formidable beak; throwing itself upon its back like a Bird of Prey. —Notwithstanding the unusual form of their beak, the *Spoonbills* also belong to this division of the family. They live by the edges of marshes, or near the sea where the ground is shaded with thick bushes; and sally forth from their cover to seize the small fishes that may approach the shore, and to pick up small mollusca, crustacea, and aquatic insects. They nestle sometimes in lofty trees,

Fig. 282.—Bittern.

sometimes in close bushes, and sometimes in tall annual herbage. Like most other Birds of the banks and shores, they are migratory; moving in the direction of the poles during the breeding season; and back again towards the equator in autumn. The White Spoonbill is an inhabitant of most parts of the Eastern Hemisphere, and occasionally visits Britain. The *Boatbill* is a Bird of the shores and marshes of Guiana, Brazil, and other parts of South America. In the form of its bill, and in its general habits, it closely resembles the Spoonbill; but its diet seems more restricted to fish.

Fig. 283.—Spoonbill.

449. The *Storks* have long, straight, robust, and rather conical bills; their legs are long, and naked high above the tarsal joint; the fore toes are connected at the base by webs, but the hind toe is placed higher. They frequent retired marshes and borders of pools; and feed upon frogs and other reptiles, mice, worms, insects, and eels, with a voracious appetite. Their habits are migratory; and the range of countries through which the same species, and even the same individual, is seen, is consequently very great. Though rare in this country (probably on account of the want of a congenial habitation), the Stork is very common in Holland and Germany, where it approaches the dwellings of Man without fear, and is treated as a welcome guest. In many countries it is held sacred, on account of the benefit it confers in the destruction of vermin; and it even, like the Vultures, cleanses the eastern cities of carrion and offal. It has been well ascertained that, after a migration of many thousands

of miles, the same pairs of Storks will regularly return to the habitations they had previously tenanted.—The *Adjutant-Stork*, or *Argala*, of India, is remarkable on several accounts. Its size is very great; its ordinary height in the erect attitude being five feet; its length from the tip of the bill to the claws being seven feet and a half; and the spread of its wings being fourteen or fifteen feet. The beak is of enormous size and strength; the head is large; and the neck proportionally muscular. The head and neck are nearly bare of skin; and from the under part of the neck there hangs a large pouch of skin, like a dewlap, which is capable of being inflated, and which gives to the Bird a very strange appearance. The Adjutant is a native of the warmer parts of India; and is very useful in removing noxious animals and carrion, which it devours with great voracity. It swallows snakes, lizards, frogs, &c.; as well as offal of all kinds; and in the craw of one of these birds has been found a land tortoise ten inches long, together with the entire body of a large black cat. In its wild state, it usually lives in companies; and chiefly frequents the mouths of rivers; it may be readily domesticated, but is very apt to display its voracity by purloining articles of food, and makes no difficulty in swallowing a leg of mutton, a fowl, or a hare, at one mouthful. From this Bird, and from an allied species in Senegal, the beautiful Marabou feathers are obtained.—The *Ibises* have long arched bills, with a blunt point; in their general conformation and habits, they closely approach the Storks (Fig. 188). One species, which inhabits Egypt, is celebrated as the *Sacred Ibis* of the ancient Egyptians, who entertained it in their temples with the observances of religious worship, embalmed it after death,

Fig. 284.—Pouched Adjutant.

and sculptured it upon their monuments. Various reasons have been assigned for these honours; according to some, it was on account of its utility in destroying serpents,—which seems doubtful; the more probable opinion is, that its appearance announced the rise of the Nile, on which (as is well known) the fertility of the country entirely depends.

450. The members of the family SCOLOPACIDÆ, or *Snipe* tribe, are all inhabitants of marshy lands, the borders of swamps, lakes, and rivers, and the sea shore. Their food consists of insects, worms, slugs, aquatic mollusks, &c.; and they usually obtain it by thrusting their long bills into the mud or moist earth. For this purpose they are provided with a very peculiar distribution of nerves upon the bill, which render its exterior sensible, especially towards its tip, the membrane of which is almost pulpy; and in many species there is a peculiar muscle, that enables the Bird to separate the flexible points of the mandibles, so as to seize its prey the moment it is felt, whilst the bill is still buried in the ground. The distribution of this family is very general; all the Birds which it contains being more or less migratory in their habits; and their powers of flight considerable. These Birds so much resemble each other in their general conformation and habits, that it will not be necessary to do much more than mention the principal species included in this family. The *Snipes* have a long, straight, compressed, and slender beak; the legs slender and short; the toes rather long, and not united at their base. They mostly breed in high latitudes, and pass southwards at the approach of winter. The British islands are thus visited by four species; the *Common Snipe*, which sometimes breeds in our own country; the *Solitary* or *Great Snipe*, which is comparatively rare; the *Jack Snipe*, a much smaller species; and the *Woodcock*, which also breeds in our islands. This last Bird conceals itself in woods, thickets, or brakes, during the day; but proceeds at night to damp meadows or

FIG. 285.—SNIPE.

swampy open ground in search of its food, of which earth-worms constitute a very large proportion. Its voracity is very great; a single individual having been known to consume within one night more earth-worms than half filled a garden-pot of moderate size.—The *Sandpipers* and their allies constitute a numerous group, which chiefly frequent saline marshes and the sea-shore; though some prefer the margin of inland lakes and rivers. They associate in flocks, and perform periodical migrations in large bodies. Their food consists of worms, crustacea, and small mollusks; this is obtained rather from the surface than beneath it,—the bill not being so sensitive as in the Snipes. They undergo a double annual moult, the summer livery differing remarkably from that of the winter. Many of the species are very widely diffused; the *Marsh Sandpiper*, for instance, being found in the north of Europe and in the Indian Archipelago; and the *Willet* being common to Europe and America. One of the most remarkable species of this group is the *Ruff*, of which the female is known as the *Reeve*. It breeds in the fenny parts of Britain, but departs southwards for the winter. Soon after its spring arrival in the breeding-places, a ruff of beautiful long plumes is developed round the neck of the male; this disappears at the end of June. It is remarkable for the diversity of its colouring; the hues not being alike in any two instances. A very extraordinary degree of pugnacity is displayed by the males at the commencement of the breeding season; this does not abate in confinement; and such fierce conflicts are excited by merely setting a bowl of food before them, that the results are sometimes fatal to the weaker. The *Curlew*, *Whimbrel*, and *Godwit*, also belong to this family; their bills are long, slender, and slightly curved; and are used to obtain food from the mud and oozy ground, in the same manner as those of the Snipes. They mostly breed in the high northern latitudes, and visit us only for the winter; but they are known to breed occasionally in Britain.

451. Nearly allied to the preceding, but classed as a distinct family by some Ornithologists, are the *Stilts*, or *Stilt-Plovers*, and the *Avocet*; which are remarkable for the extreme length and

slenderness of their legs, and for the peculiar form of their bills. Although not numerous, the *Stilts* are found in every quarter of the globe; the species which occasionally visits England and western Europe, being spread throughout Asia and Africa,—another being met with in Australia,—and two others in America. They frequent marshes, shallow-lakes, salt pools, &c.; and feed upon minute shell-fish, insects, crustacea, &c. They construct their nests in the vicinity of these; six or eight pairs uniting to build a sort of platform, by which the nests may be raised above the level of the water. The immense length of their legs, and the wide spread of their toes, adapts them admirably for wading; and when they get beyond their depth, they can swim with facility; but they cannot walk with steadiness upon hard ground. Their wings are long, however, and they fly with great swiftness. In the *Avocet*, the bill is of extraordinary length, and slenderness; and curves upwards towards the tip. Although this conformation renders it unfit for being plunged in the mud in search of food, it adapts it most admirably to skim its surface in the manner of a light scoop; and thus to take up the minute insects and worms on which the Bird feeds. The way in which it avails itself of the harvest of worms and larvæ, small crustaceous and molluscous animals, the spawn of fishes, &c., which are half imbedded in the mud at the bottom of the fens and

Fig. 286.—Stilt.

Fig. 287.—Avocet.

water-courses it frequents, has some resemblance to moving. It moves forwards with slow but rather lengthy steps; and scoops the ooze or mud in curves, right and left, as it proceeds. The traces of its scoopings may be seen in the places where the Bird has been feeding; until they are effaced by the tide. In this action it does not move the bill alone, but the whole body; stretching it on either side from the fixed point in the feet, so that the bill has a very wide range, considering its length, which is about $3\frac{1}{2}$ inches. The Avocet was formerly not uncommon in England; but it is now rare, even in the fenny districts. It abounds, however, in Holland; and is diffused over Europe, Asia, and Africa. It is not properly a migrating Bird; but frequents the inland fens and saline marshes during the breeding season; and resorts to the neighbourhood of the shore in winter, for a better supply of food.

452. We have lastly to notice the family of RALLIDÆ, or *Rails;* in which we find many of the characters of the next order. The toes are long and slender; the hind one is placed on a level with the others; and they often have a membranous margin along their sides, by which their surface is extended for swimming, or for treading on oozy ground (Fig. 288). Their bodies, too, are generally compressed; so as to move with greater facility through the water, or to make their way through closely-set herbage. The family includes, however, Birds of considerable variety of structure and habit; from the diving and swimming Coot to the terrestrial

FIG. 288.—FOOT OF COOT AND GALLINULE.

Land-Rail. "The Rallidæ have to thread their way through beds of thick-set stems of reeds, bulrushes, and other aquatic plants, among which they seek shelter and concealment; or, as in the case of the Land-Rail, through the tall grass of the meadow;—and that so rapidly and noiselessly, that the field seems traversed by magic. Hence they elude pursuit with great ease, and can seldom be forced to take wing."—The *Rails* have a lengthened, slender, and slightly-arched bill. They mostly seek the shelter of tall herbage; the *Water-Rails* tenanting thick reed-beds, on the borders of the marshes and ponds in which they seek their food; whilst the *Land-Rails*, or *Crakes* frequent the fertile meadows, and feed on vegetables and seeds as well as on worms and insects.—The *Gallinules*, or *Moor-Hens*, are more exclusively aquatic in their habits; and are able not only to swim with facility, but even to dive. They have a short and straight bill, the cutting edges of the upper mandible falling over those of the lower; and their food consists of aquatic weeds and corn-grains, in addition to aquatic larvæ, worms, &c.—The *Coots* have a strong, straight, somewhat conical bill; and a membranous border to the toes. They swim and dive with great address, and are not inactive on land. The British species is very generally spread over temperate Europe; and is particularly abundant in Holland. It frequents large sheets of water, on the very edge of which it builds its nest; and migrates in the winter, when the inland waters are frozen, to the saline marshes, estuaries, &c., of our southern coasts.—The *Jacanas* and *Screamers* of tropical climates, are usually placed in this family; though sometimes separated into a distinct group. They are remarkable for the great length of their toes, and of their spine-like claws, especially that of the hinder toe. Various species of the Jacana, which in contour and habit resemble our Moor-Hen, are spread over the tropical regions both of the Old and New World. They are very light birds; and the wide surface over which their toes extend, enables them to walk over the floating leaves of plants with great facility, so that they really seem as if they were treading upon water.—The *Screamers*, which are confined to South America, are remarkable not merely

for their harsh and discordant voices, but for the sharp hard spurs with which the wings are armed at the shoulder joint. These are very efficient weapons of defence; and enable the birds to resist the attacks of the Snakes, which infest the places they inhabit. One species is also remarkable for the possession of a slender pointed horn, three or four inches in length, which arises from the top of the head, and curves gently forwards. The use of this singular appendage is unknown.

Order VII.—NATATORES.

453. The *Swimmers* or *Web-footed* Birds are, of all the orders of the feathered race, the most easily distinguishable, on account of the peculiar structure and position of their oar-like feet. These members are placed very far back, so as to be more efficient instruments for the propulsion of the body in water; but this arrangement gives to the Birds an awkward waddling gait on land. The feet are always webbed;—that is, the toes are connected together by a membrane; but this in a different manner in the different families. In making the swimming-stroke, the foot is first drawn forwards; and the toes then close together, and the webs fold, so as to offer to the water the least possible resistance: but when the back-stroke is made, the toes spread out, so as to present a large surface to the water. The form of the body is boat-shaped, so as to move through the water with little resistance; and the neck is usually long, so as to enable the Bird to plunge the head far down in search of its food. The tail is generally short; in some instances it is composed of rigid feathers, and serves as a rudder to direct the Bird in the act of diving; but in some of the aquatic Birds it is very long, and guides them in their rapid flight. The form and size of the wings, and the powers of flight, vary greatly in the different tribes of this order; some of them are almost unsurpassed in the extent of their wings; whilst in others, these organs are so short as to be utterly useless in flight, and can be only used as paddles for urging them through the water. The plumage is dense, and is oiled by a secretion

from certain glands near the tail, so as to throw off the water without being wetted by it; and there is generally an undergarment of down, which is especially thick beneath the body. The food of these Birds usually consists of fish, mollusks, and insects. They live much more upon or in the water, than on land; and resort to the shore chiefly for the purpose of building their nests and rearing their young. One male usually associates with several females, and leaves to them the cares of incubation. The nest is rudely constructed, and is placed either upon the ground, or upon the low vegetation in the neighbourhood of water; and the young are hatched in a condition that enables them immediately to run about and seek their own food. —This Order includes five families;—the ANATIDÆ, or *Ducks;* the COLYMBIDÆ, or *Divers;* the ALCIDÆ, or *Auks;* the LARIDÆ, or *Gulls;* and the PELECANIDÆ, or *Pelicans*.

454. The ANATIDÆ, or *Duck* tribe, are distinguished by the breadth and depression of the bill, which is covered with a soft sensitive skin; and by the separation of the hind toe, which is not included in the web. The bill is furnished with a set of laminæ or horny plates at the edge of each mandible; the use of which appears to be, to filter the fluid taken up by the bill, allowing the water to escape, and retaining the solid substances included in it,—thus serving very much the same purpose as the sieve of Whalebone in the mouth of the Whale (§ 214). The selection and appropriation of the food is further aided by the tongue; which, instead of being slender and horny, is large and fleshy. The gizzard is strong and muscular, and is lined in many species by a very thick, tough, and almost horny coat, so as to be capable of grinding down the food, which is usually more or less of a vegetable nature. The Anatidæ are dispersed over every part of the globe, and are usually more or less migratory in their habits. Their flight is vigorous and rapid; and it is generally at a high elevation.—As connecting this family with the preceding order, we must notice the extraordinary *Flamingo;* which, from the length of its legs and neck, would seem to be a Wading Bird; but which, in the complete palmation (webbing) of its feet, and in the form and structure

of its bill, would rather seem to belong to the Duck tribe. The beak would closely resemble that of a Swan, were it not bent down abruptly in the middle; and by this change of form, it is adapted to be used in a position contrary to the usual one,—the head being so bent down, that the upper mandible, not the lower, is applied to the mud and ooze in which the Bird is seeking its food. The edges of the mandibles are laminated, as in the Ducks; and the tongue is fleshy, and beset with rows of curved spines. The Flamingoes are waders in their habits, chiefly frequenting low muddy coasts, the mouths of large rivers, creeks, lagoons, and inland lakes. The European species is seen on the shores of the Mediterranean; but it is more abundant in Southern Africa, and on the shores of the Caspian.

FIG. 289.—FLAMINGO.

455. Of the true ANATIDÆ, the *Geese* seem best adapted for an inland residence; their food consists chiefly of grain or grass; and their legs are placed further forwards than in the Ducks. The parent-stock of our domesticated breeds—the common *Wild Goose* or *Grey Lag Goose*, is still extant in some parts of England, though its numbers are diminishing in consequence of the extension of cultivation. It ranges over the greater part of the temperate regions of the Old World; and is replaced in the New by a species very closely allied to it, and equally domesticable,—the *Canada Goose*. Still further north is found the *Snow Goose*, which seems altogether confined to the Arctic regions.—The *Brent Goose* is a much smaller Bird than the

Common Goose, but has much longer wings: and it traverses greater distances in its migrations. Its breeding-places are in

Fig. 290.—Brent Goose.

the far north; but it migrates for the winter as low down as the middle of France, and has been known (when the season has been very severe) to attack the corn-fields in such numbers, as to produce the most serious injury. Nearly allied to this is the *Barnacle Goose;* of whose origin from the *Barnacles* attached to floating timber, &c., such strange stories are told by the older naturalists.—The *Swans* are more purely aquatic in their habits; but their diet consists chiefly of the roots of aquatic plants, and other vegetable matter, which they obtain by means of their long necks. They are distributed through all parts of the world; and are remarkable for their graceful appearance upon the water, which is familiar to every one.—The *Ducks* are destined to feed in great part upon animal matter, such as insects and mollusks; as well as upon vegetables and grains. They are inhabitants of various parts of the world, and are generally seen upon the lakes and rivers of the interior, though they occasionally resort to the sea-shore. Ducks can all swim and dive with facility; they can all fly well; and they can all walk, though frequently with difficulty. The number of species is very numerous; and they may be arranged under two subdivisions, according to their habits, and the peculiarities of structure which correspond to them.—The Ducks of the first section live for the most part inland, and frequent shallow

waters, very seldom immersing the whole body; the feet are placed farther forwards than in the other section, so that walking is easier; the wings are longer; the swimming-web is less extensive, and the hind-toe is free. They employ their wings and legs considerably in flying or walking from one part of the shallow to another; and their food consists of vegetable matter, as well as of small animals. To this section belong the common *Mallard* or *Wild Duck* (the origin of our domesticated breeds),

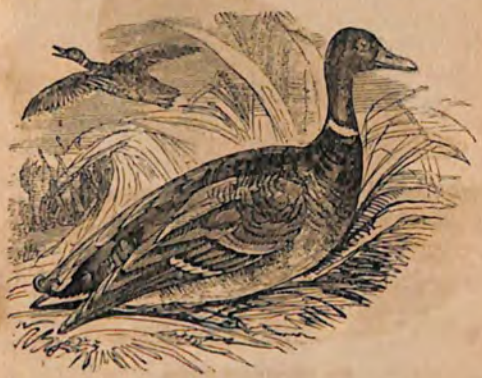


Fig. 291.—Mallard

the Sheldrake, Teal, Widgeon, Muscovy Duck, and many other species.—The Ducks of the second section are inhabitants of deeper waters and of the sea. The hind-toe is included in the membranous web; and the expanse of this is considerably greater; so that the swimming powers are much increased. Most of them, too, are good divers; and obtain their food, which consists of small crabs, shell-fish, and aquatic plants, by immersing the whole body in water. The neck is shorter, and not so much adapted for dabbling in water; the wings are smaller and less powerful; and the legs are placed far back. This group includes the Scoters, Eiders, Pochard, Scaup, Golden-Eye, and many other species more or less known upon our coasts. The *Scoters* are altogether marine in their habits, and obtain their food by diving. They chiefly live upon fish and mollusks; and their flesh has a rank fishy taste., They are

common on the northern shores of both continents during the winter, and retire to the extreme north to breed during the

Fig. 292.—Black Scoter.

summer months. Their plumage is for the most part dark, or even quite black; but it is very close and stiff, so that it receives no injury from immersion in water. The *Eiders* are the largest of all the Ducks, being as weighty as the average of Geese. They are remarkable for the extraordinary coating of down, with which their bodies are covered; and for this their nests are sought with eagerness by the Fowler, a considerable quantity of it being plucked off by the female for their lining. When the eggs and

Fig. 293.—Eider Duck.

their covering of down have been taken away, the female will again lay; and when she has nearly stripped herself of down, the male affords some of his. The breeding-places of this Bird are situated for the most part in the arctic regions; and it is only an accidental visitor to our southern coasts. The shores of Iceland, Greenland, Lapland, Spitzbergen, and those of Labrador, Hudson's, and Baffin's Bays are its chief resorts. During the summer months, these Birds are often met with floating in pairs, or solitary, at a considerable distance from land, though usually in the neighbourhood of ice.—The last division of this family consists of the *Merganser*s or *Gooseanders;* which

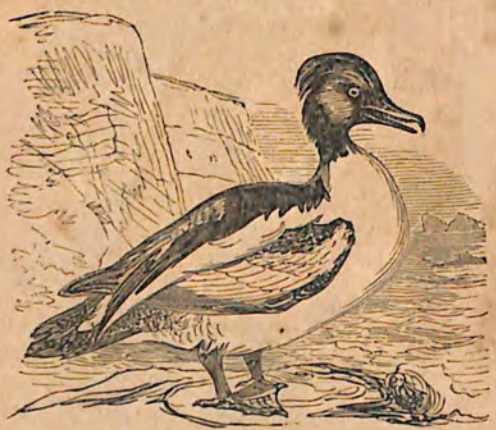


Fig. 294.—Merganser.

have narrow cylindrical bills, with the margin jagged like a saw, and the tip armed with a hooked nail. They are inhabitants of the arctic regions, breeding very far north in summer, and migrating southwards in winter, — though few, even then, advance far into the temperate zone. Their food consists principally of fish, which they take by rapid diving; also of small crabs and insects. They seem never to feed upon land; and to be incapable of digesting vegetable matter of any kind.

456. The family of Colymbidæ, or *Divers*, have short wings; and the legs are placed so far back on the body, that they always

assume an erect position when standing. The bill is compressed at the tip, and pointed. Some of them even suspend their nests on rushes at the surface of the water. The true *Divers* have

Fig. 295.—Great Northern Diver.

the feet large, all the front toes entirely webbed, and the hind toe connected to the outer membrane of the inner one.—They are found in the northern regions; visiting the lakes of the interior during the breeding season. They are rapid and powerful divers; feeding on fish, and sometimes on vegetables.—The *Grebes* have their toes flattened, separate, but broadly fringed at their edges by a firm membrane; this division of the webbed foot probably assists its action, in waters where there is a good deal of vegetation. The quickness with which they dive is extremely remarkable; they have been seen to plunge with sufficient rapidity to avoid the shot of a fowling-piece, by whose

discharge they were alarmed; and then to come up at two hundred yards' distance. Their progression on land, however, is extremely awkward; for they are obliged to lie upon the whole length of the body, and then to shuffle along like Seals, by the action of their feet against the ground. Their flight is feeble, but their wings give much assistance in the act of diving.

Fig. 296.—Little Grebe.

457. The family Alcidæ, or *Auks*, have, like the Divers, very short wings, and the legs placed far behind the centre of the body, so that they stand nearly erect; but they have the toes all united with a web. They pass a large part of their time in the waters of the ocean; and nestle upon its borders. The power of the wings is extremely limited; and in one tribe they are only capable of acting as paddles, to assist the motion of the Bird in the water. The form of the bill varies in the different genera; but it is usually compressed, and the tip is very commonly hooked. In the *Auks*, or *Razor-bills*, the wings are perfectly formed, though short; and the hind toe is wanting. These Birds are found in the Northern Ocean, and appear in more temperate climates during the winter. They feed on fish, small crabs, &c. They never leave the water, except for the purposes of incubation; and they breed on the ledges of

Fig. 297.—Great Auk.

precipices, in caverns, and in deep fissures of the rocks. When on land, they shuffle along in a very awkward manner; and sometimes use the bill to draw themselves upwards on the shore; but in water, they dash along with the ease and velocity of fishes. Nearly allied to the Auks are the *Puffins*, which are

Fig. 296.—Common Puffin.

abundant on the shores of all the northern seas, breeding in holes and crevices of rocks, but not resorting to the land at any other time. They breed on many parts of our own coasts; such as Dover Cliffs, the Needles, and the Farn islands of Northumberland. Their nests are much sought by fowlers, both for the eggs, and for the parent birds, the bodies of which are much relished by many as food.—The *Guillemots* strongly resemble the Auks and Puffins in their general habits; but differ in the form of the bill, which is straight and compressed. They are thick and clumsy Birds, and are almost completely destitute of the powers of walking and of flight; but they dive with great address, and catch their prey with much adroitness. The most common species is known as the Foolish Guillemot, on account of its habit of allowing itself to be taken, rather than quit its single egg. This Bird is widely spread through the northern shores, and performs a southern migration for the winter; the extent of which depends in part upon the place it has left. Thus, the Guillemots which breed on the small rocky islands near the

coast of Britain, associating with the Puffins and other Birds of the same family, pass the winter in the Mediterranean; whilst those that breed in more northern spots find a sufficient change of temperature, by passing the winter on the British shores.

458. These Birds are represented in the southern Hemisphere by the *Penguins*, an extremely remarkable group; in which the legs are placed so far back, that the body is quite upright when the Bird is standing on the ground; and the wings lose altogether the power of raising the body in the air, being covered with short rigid scale-like feathers, disposed in regular order, instead of having their surface extended by prolonged feathers (Fig. 189). The bones, unlike those of Birds in general, are hard, compact and heavy, and have no apertures for the admission of air; those of the extremities contain an oily marrow. The Penguin is exclusively a Water-Bird, except in the breeding season; and, aided by its paddle-like wings, it swims and dives with great facility. It is a courageous bird, although by no means disposed to fight. From the presence of a large number of the horny parrot-like beaks of Cuttle-fish in the specimens dissected, it may be inferred that these animals constitute a large part of their food.

459. The Birds of the family LARIDÆ, or *Gulls*, are entirely oceanic in their habits; being seldom found at any distance from the sea, and for the most part living upon its surface, even at vast distances from land. They are generally distinguished for great powers of flight; in which respect they present a remarkable contrast to the Birds of the preceding family. But, on the other hand, they are not good divers; their food being such as they may obtain at or near the surface of the water, rather than in its depths. They are distinguished by the shortness or absence of the hind toe, which is not included in the web; and by the compressed form of the bill. In the *Petrels*, which, with some allied birds, are often placed as a distinct family, the hind claw originates at once from the tarsus (like a spur), without any toe; and each mandible of the bill (which is longer than the head) terminates in a sort of hard nail, of which the upper one is abruptly hooked. The Petrels are inhabitants of

the higher latitudes of both hemispheres, and are almost constantly seen on the wing, only alighting on the ocean to take a short repose, and rarely coming to land except during the breed-season. They feed upon fish, mollusks, and floating garbage; and many species are in the habit of following ships in their course, to partake of the refuse which is thrown overboard. The larger ones will attack other Marine Birds, compelling them to give up their prey, or even destroying and devouring them. The *Stormy Petrels*, commonly known by sailors as *Mother Carey's Chickens*, are the smallest of all the web-footed Birds, and are distributed over every part of the ocean. They seem quite at their ease amidst the most violent storms, coursing over the roughest waves, and mounting through the breaking surge that threatens to overwhelm them. Hence they are so associated in the minds of seamen with the idea of tempest, that their appearance is regarded as the sure forerunner of a storm.—To this group also belongs the gigantic *Albatross*; which is one of the largest of all aquatic Birds,—its spread of wing being some-

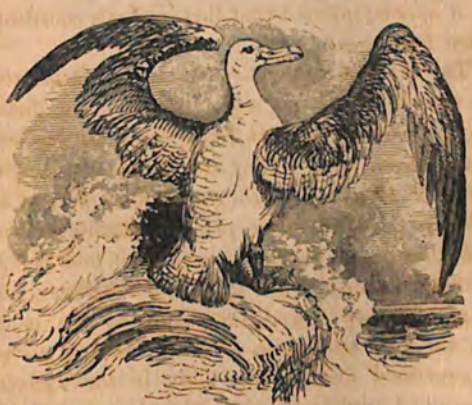


Fig. 299.—Albatross.

times fourteen feet, and its weight twenty pounds. This Bird is an inhabitant of the southern seas, where it is often seen by the voyager sailing with outspread wings around his vessel, or

sweeping over the surface in chase of flying-fish. It is extremely voracious, being often seen to swallow at one mouthful a fish of four or five pounds weight. Albatrosses are occasionally seen in the northern seas; being probably attracted thither by the migrations of fish, whose shoals they follow. Notwithstanding their large size, they are not courageous Birds; being often obliged to yield their prey to the Sea-Eagles, and even to the larger Gulls. When they meet with abundance of food, they gorge themselves until they are almost stupified, and seem to doze upon the water; and when alarmed in this state, they discharge the contents of their stomachs, which are rendered peculiarly offensive by the secretion of a quantity of acrid oil. In these habits they strongly remind us of the Vultures.

460. The true *Gulls* have the bill of moderate size, with the tip hooked and acute. They have a small hind-toe, elevated from the ground. They are found in every part of the world, and are omnivorous in their habits; and in these and other particulars, they may be regarded as representing the Crows. Some are found at a distance from the sea, feeding on slugs, worms, grubs; but the sea-shore is their usual haunt, and there they devour all kinds of garbage that the tide brings up, together with such living animals as they may obtain. They are extremely useful, therefore, in removing a great deal of matter, that would otherwise taint the air by its putrescence. Thus if a Whale is thrown ashore in the Orkney Islands, its carcase is speedily devoured by innumerable Gulls, which flock, in a wonderfully short space of time, to any spot where food is to be had. They frequent the neighbourhood of fishing villages; and are very

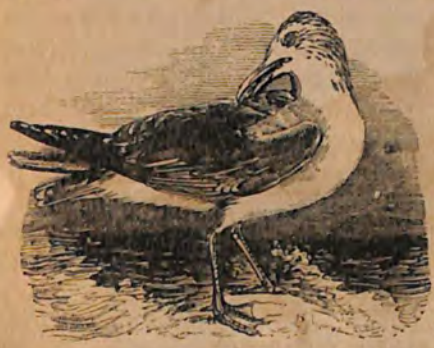


Fig. 300.—Common Gull.

serviceable in carrying off the refuse that is left by Man.—The *Skuas* are a tribe of Gulls which are larger than the rest, and which obtain their chief subsistence by robbing other marine birds of their prey. The *Common Skua*, which is abundant on many parts of the British shores, is not much inferior to the Eagles in size and strength; and as it is a courageous Bird, it has no difficulty in keeping the smaller Gulls in subjection, though it is not known to attack them for the sake of devouring their bodies. It is accused, in the Orkney and Shetland Islands, of attacking lambs; but this is unlikely,—though it may very probably feed on the bodies of such, as it finds dead in the pastures. Although the claws are strong and crooked, these birds cannot carry off anything in them, from the want of an efficient hind-toe, against which to act.—The *Terns*, or *Sea-Swallows*, have a lengthened, straight, and slender bill, rather

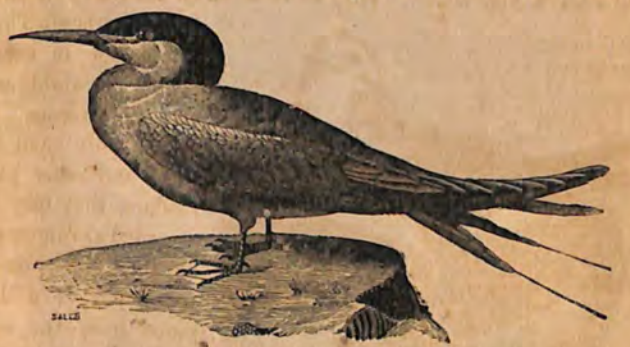


Fig. 301.—Tern, or Sea-Swallow.

curved at the tip; their wings are long and pointed; and their tails forked. These birds are met with on almost every sea-coast in the world, and occasionally proceed inland to the lakes, &c. They are continually seen on the wing, and are sometimes found at very great distances from land. Their food consists principally of fish; some also attack the eggs and young of water-birds; and others feed only on insects, like the Swallows, which they so much resemble. They are migratory in their habits, passing southwards in the winter, in large flocks. Some

of the Gulls, also, change their abodes periodically; but rather, it would seem, for the purposes of breeding, or for seeking their food, than for a change of temperature.

461. The last family of Natatores is that of PELECANIDÆ or the *Pelican* tribe, the birds of which are at once distinguished from the preceding by the length of the hind toe, and its union with the rest in the web (Fig. 190); they are consequently excellent swimmers, and they often perch upon trees. The edge of the beak is generally toothed; and their throat is dilated into a bag, in which they keep the fish as they catch them, to feed their young.—The *Darters* have a long slender bill, broad at the base, but much compressed and acute at the tips. They live in small flocks; perching on trees by the sides of rivers, lakes, and lagoons, at no great distance from the shore; and darting at fish with their long slender bills and flexible necks. They thus bear a strong resemblance to the Kingfishers. If alarmed on their perch, they plunge directly into the water almost as if shot, swim for some distance beneath the surface, and then re-appear and dart into the air like an arrow. Their nests are rudely formed of sticks, in the tops of trees. The Darters are found near the eastern coasts of the tropical parts of America; and on the western coast of tropical Africa.—The *Tropic-birds* have a long bill, broad at the base, with the edges of the mandibles finely serrated. The general form of the body is like that of the Gulls; but there are two narrow middle feathers, which are prolonged far backwards. They are found in tropical climates, where they catch the Flying-fish, &c., on which they prey,—hovering over the water, and then suddenly darting down upon any fish within their reach. They rarely, if ever, settle upon the water; but return every evening to their

FIG. 702.—DARTER.

roosting-places on the shore. If far out at sea, however, they will fly all night. Their movements are remarkably graceful. It is in the *Pelicans* and their allies, that we find the pouch beneath the mouth most developed. Their bill is long and straight, and the tip hooked; the lower mandible is composed of two flexible branches united only at the point; and the cheeks and throat are bare of feathers. Their powers of flight are very great; and this seems due not only to the great extent of their wings, but also to the large size of the air-cells, which are more extensive than in any other Birds. The *Pelican* is an

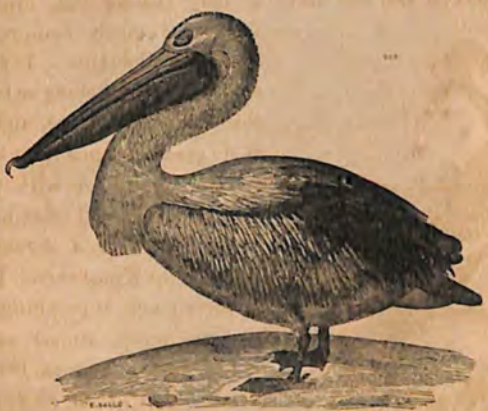


Fig. 303.—Pelican.

inhabitant of tropical climates, usually keeping near the shore, but sometimes going inland for the purposes of incubation. It hovers over the surface of the water, watching the shoals of fish beneath; then suddenly descends, sinking deep into the water, and using its bill as a scoop, by which it entraps its finny prey; and rising to the surface by its own buoyancy, immediately ascends again on expanded wings. Its pouch is so capacious, that it will hold, when distended, two gallons of water. The *Gannet*, or *Solan Goose*, of our own coasts,—the *Brown Gannet*, or *Booby* of the South Seas (so called from its apathy in allowing itself to be taken or knocked on the head),—the

Cormorant, which ranges from Britain to America and India,—and the *Frigate*, or *Man-of-War Bird*, of the tropics, are all

Fig. 304.—Frigate Bird.

closely allied to the Pelican in structure, and resemble it in habits. The last-named Bird is remarkable for its extent of wing, and for its habit of tyrannising over the Gulls and Boobies, from which it forces the prey they have captured.

ROYAL BOMB

CHAPTER V.

CLASS OF REPTILES.

462. The class of Reptiles comprises all the cold-blooded Vertebrated animals, whose respiration is aërial and incomplete in all stages of their existence. They have lungs, as Mammalia and Birds; but their circulating apparatus is always arranged in such a manner, that a part of the venous blood is mixed with arterial blood without having traversed the respiratory organ. This mixture usually takes place in the heart; which only possesses a single ventricle, into which open the two auricles. In their general form, Reptiles approach Mammalia nearer than Birds; but they offer in this respect many variations, as may be seen by comparing together a Tortoise (Fig. 316), a Crocodile (Fig. 319), a Lizard (Fig. 323), and a Serpent (Fig. 329). Their head is almost always small, and their body very much lengthened out; some, as Serpents, are entirely destitute of members, or have only traces of them; but the greater number of these animals, Lizards and Tortoises for instance, have four limbs, formed so as to serve for walking or swimming. Further, these members are generally too short to prevent the trunk from dragging on the earth; hence, most Reptiles are accustomed to crawl rather than walk; from which circumstance it is that their name is derived.*

463. The skeleton in this class presents much greater variations in its structure than in warm-blooded Vertebrata. All the parts of which it is composed are wanting in one or another group, excepting the head, and the vertebral column and ribs; but the bones of which these are composed always preserve a great resemblance to those of Mammalia and Birds, and are easily

* The Latin *repto* means, to crawl, or creep.

recognised as being analogous to them. The skull is always small, and the face lengthened; the lower jaw is composed of several pieces, as in Birds; and is articulated to a bone distinct from the temporal (the *os quadratum*, or *tympanic* bone, § 326). Sometimes even this bone is, in its turn, suspended to a movable lever; an arrangement which greatly increases the dilatability of the mouth, as we shall presently see when speaking of the deglutition of Serpents. The upper jaw is generally immovable; but in Serpents it is articulated so as to execute certain movements. Amongst several reptiles, Lizards and Tortoises for example, the bones of the cranium are prolonged laterally over the temples, in the manner of a shield, and thus give to the head a considerable length. Lastly, the head is in general but slightly movable; and is articulated upon the vertebral column by means of a single condyle. The bones of the trunk present, in their arrangement and number, more considerable variations. In Lizards, Crocodiles, and other Reptiles formed on nearly the same plan, there are generally but few anomalies to be remarked; and we shall only notice, that the ribs are more numerous than in Mammalia or Birds; and that they protect the abdomen, as well as the thoracic portion of the body. Amongst Serpents, the sternum is wanting, as well as the bones of the members; and the ribs, whose number is very great, are free at their lower extremity: we sometimes count more than 300 pairs of them, in the Colubers for example; and they are so movable, that the animal employs them as supports in its crawling motion. The vertebræ also possess great mobility; and are articulated together by means of a rounded eminence on each, received into a corresponding cavity in the next, and held by the aid of ligaments; so as to form a series of ball-and-socket joints (ANIM. PHYSIOL. § 629). But it is in the Tortoise tribe that the conformation of these bones is the most remarkable; for they form two great *shields*, between which the animal can generally withdraw itself completely. One of these shields occupies the back, and is named the *carapace;* the other, situated under the body, is called the *plastron*. (Fig. 317.) They are united together on each side, in such a manner as to

leave, in front and behind, an opening that serves for the passage of the head, feet, and tail. This kind of cuirass is only covered by the skin, which, in its turn, is generally furnished with large scaly plates; and all the muscles and other soft parts are enclosed in the great cavity thus formed.

464. The osseous framework of Tortoises, in order to present this unusual arrangement, must necessarily, it is evident, be greatly modified: we nevertheless find the same constituent parts as in ordinary Vertebrata; but several of these pieces have changed their form and size. When we examine the carapace on its upper surface, we see that it is formed by a great number of bony plates, united together by sutures; of these plates, eight occupy the median line, sixteen constitute a longitudinal range on each side of these, and twenty-five or twenty-six surround the whole like an oval frame. It is difficult then to recognise the nature of these bones; but if we examine the carapace by its lower surface (Fig. 305), we immediately see that the central pieces, of which we have just spoken, are nothing else than appendages of the dorsal vertebræ. On the under side, the body of each of these bones is found, in fact, to present its ordinary form; as is also the vertebral canal, which serves to lodge the spinal cord; but the upper portion of the walls of the ring which constitute this canal,—instead of having its usual form of a simple transverse arch of bone separated by a void space from those above and below, and instead of being surmounted by a spinous process,—is here spread out sideways as a disk, and is continuous without interruption with the corresponding plates, belonging to the vertebra which precedes, and to that which follows. These dorsal vertebræ, thus become immovable, have attached to each a pair of ribs, as in Man and most other Vertebrata; but these ribs (*c*) are so much widened, as to touch each other along the whole, or nearly the whole, of their length, and are connected together by sutures.* Finally, the marginal pieces, which are articulated with the extremities of the ribs, and which form a kind of border to

* The flattened costal pieces of the carapace are now generally regarded as belonging to the skin, or rather as being composed of the ribs amalgamated with *dermal* bones.

the carapace, evidently represent the sternal portions of these

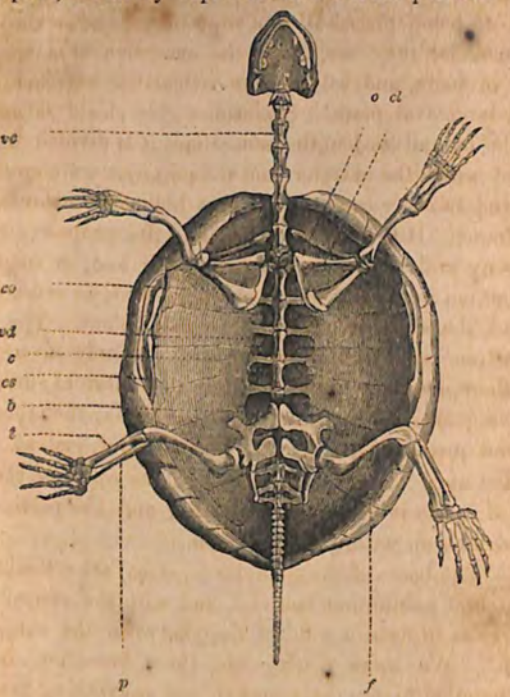


FIG. 305.—SKELETON OF LAND TORTOISE, WITH THE PLASTRON REMOVED.

vc, cervical vertebræ; *vd*, dorsal vertebræ; *c*, ribs; *cs*, sternal ribs, or marginal pieces of the carapace; *o*, scapula; *cl*, clavicle; *co*, coracoid bone; *b*, pelvis; *f*, femur; *t*, tibia; *p*, fibula.

bones; which, in Mammalia, remain in a cartilaginous state, but which amongst Birds are completely ossified.* In some Tortoises, even, they remain cartilaginous; and in almost all these animals several of them are supported at their edges upon the borders of the Plastron.

465. The *plastron* is formed by the sternum, which presents an extraordinary development, and is extended from the base of the neck to the commencement of the tail. (Fig. 317). The

* This view is also given up, and the marginal plates are now considered to belong to the dermal skeleton.

pieces which enter into its formation are nine in number; and, instead of being placed all in a row, the one after the other as in Mammalia, they are, with the exception of a single one, ranged in pairs, and soldered or articulated together, so as to form a large oval plate. Sometimes this shield is entire and solid through all its length; sometimes it is divided into three parts, of which the anterior and the posterior are slightly movable; and in other cases, again, it is hollowed out in the centre like a frame. It is fixed on each side to the carapace, either by a large bony prolongation, or by cartilages; and, in front as well as behind, an interval is left between the two, in order to allow the head, the members, and the tail to pass out. The carapace and plastron, as we have already said, are only covered by the skin; there is no muscle inserted on the external surface; and it is consequently in the interior of the trunk, that those of the neck and members are fixed. The shoulder, instead of being supported upon the external surface of the walls of the thorax, is lodged in the interior of this cavity; and the pelvis is, so to speak, drawn up within the abdomen.

466. The bones of the shoulder (*o*, *cl*, *co*) are articulated with the vertebral column, at one end, and with the sternum, at the other; so as to form a kind of ring between the carapace and plastron. We there distinguish three branches, frequently united together at an early period, and converging towards the articular cavity of the humerus, which is formed by their meeting. One of these bones (*o*), suspended to the vertebral column, is evidently the *scapula*? the second (*co*), which is directed backwards, is analogous to the *coracoid bone* of Birds; and the third (*cl*), which descends to unite with the plastron, is the representative of the *clavicle*.—The pelvis bears a great resemblance to the ring formed by the bones of the shoulder. It is composed of three pairs of distinct pieces;—an *iliac bone*, which is attached to the transverse processes of the posterior vertebræ of the carapace; a *pubis*, and an *ischium*, which are both directed towards the plastron, and are united to their fellows.

467. In other Reptiles, the form of the bones of the shoulder bears a greater resemblance to that which we have already seen

in Birds. The members do not in general present anything very remarkable. Sometimes they are abruptly terminated at the end, and can only serve to push the animal forward, as in Land Tortoises for example ; sometimes they are terminated by slender fingers, and furnished with claws, which allow the animal to hook itself on by inequalities of the surface, and to climb with facility ; the feet of many Lizards are formed in this way, and those of tropical climates are described as exhibiting astonishing agility in climbing, running up perpendicular surfaces, and springing from one point to another with remarkable ease and certainty. In other instances there is at the extremity of the fingers a particular arrangement, which is singularly favourable to this kind of movement ; thus, among the *Geckos* (Fig. 323) the fingers are very much expanded towards the end, and furnished underneath with little folds of skin, which appear to perform the function of suckers, and which permit these hideous Reptiles to ascend along the smoothest walls, and even to walk in an inverted position upon ceilings. There are also some Reptiles whose fingers are opposable, almost as in the hand of Man ; in fact, among *Chameleons* (Fig. 322) they are united in two sets, which spread out and approach each other, like the arms of a pair of pincers, and which enable these animals to take a firm hold of the branches on which they rest ; Chameleons have also a prehensile tail, which makes them essentially climbing animals. Finally, in other Reptiles adapted to a life more or less aquatic, the fingers are sometimes webbed, as is seen in the posterior feet of the Crocodile ; and perhaps still more strikingly amongst the fresh-water Tortoises ; or are even transformed to a kind of flattened paddle, unfit for walking, but very favourable for swimming. The Turtles (Fig. 318) are the only Reptiles which at the present time possess this last form of structure ; but at more remote periods of the geological history of the globe, our seas were peopled with large animals provided with similar paddles, and presenting as to the rest of the body great resemblance to Lizards and Serpents ; some of these skeletons have been discovered in the fossil state, and they have been designated by the names of *Ichthyosaurus* (Fig. 320) and *Plesiosaurus* (Fig. 321).

468. We are also acquainted with Reptiles possessing wings. The *Dragons* (Fig. 306), animals nearly allied to Lizards, are of

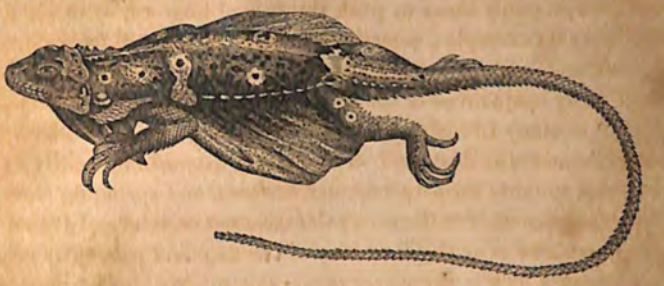


Fig. 306.—Draco Volans.

this number. They are distinguished from all other animals of the same class, by the existence of a broad fold of skin, situated along each flank, and much resembling the wings of Bats; but this, instead of being sustained and put in motion by the anterior members, is altogether independent of them, and is supported by the six first false ribs, extended horizontally in a straight line. The animal makes use of them as a parachute to sustain itself in the air, whilst it leaps from branch to branch; but it cannot move them with sufficient force to fly like a Bat or Bird. These

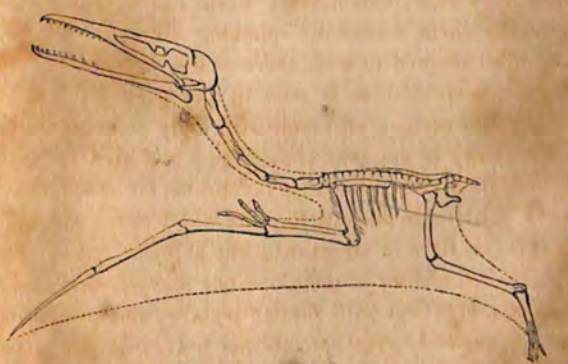


Fig. 307.—Pterodactylus.

singular Reptiles, which inhabit India, realise therefore, up to a

certain point, the fabulous Flying Lizards and Serpents, of antiquity; but the Dragons of zoologists, instead of being formidable animals, like those of poets, are of very small size, and only attack insects.—At the epoch in which lived the Icthyosauri and Plesiosauri, of which we have just spoken, there also existed a flying Reptile still more singular than the Dragon. From the structure of its bony framework, we see that, like our Bats, it had the power both of walking on the ground and of flying; for its posterior feet and all the fingers of its anterior feet, one alone excepted, are formed in the ordinary manner; but the second finger of the anterior members, is more than twice the length of the trunk, and probably served to sustain a fold of the skin adapted to fulfil the functions of wings. In order to designate this singular conformation, the generic name of *Pterodactylus* (or finger-winged) has been given to these Saurian fossils.

469. The movements of Reptiles are generally less lively and prolonged, than those of Mammalia and Birds; as, indeed, might have been anticipated from the more limited extent of their respiration; for there always exists, as we have already seen, an intimate relation between the energy of the two functions. Their muscles receive less blood, and present a pale hue. But it is likewise to be remarked, that these organs preserve their irritability for a longer time, after they have been removed from the influence of the nervous system. Among warm-blooded animals, the destruction of the brain and spinal cord, or the section of a nerve, immediately causes a complete paralysis, either general or local; and in a short time after this has taken place, it becomes impossible to excite muscular contractions, by pricking or otherwise stimulating the affected parts. Among Reptiles, on the contrary, the power of executing movements under the influence of these stimulants, is preserved, in similar circumstances, for a long time; thus the tail of the Lizard, detached from the body, continues to move for several hours; and it often happens, that the limbs of a Tortoise which has been dead for several days are seen to move convulsively, when the muscles are stimulated by being pricked.

470. The brain of Reptiles is very little developed; the sur-

face of the cerebrum is smooth, and without convolutions (Fig. 308). The two hemispheres (*a*) are oval, more or less elongated, and hollowed out in the interior into a ventricle, as in Birds; there is no corpus striatum; and at their anterior part there are often observed olfactory lobes of moderate size, situated at the origin of the first pair of nerves. The optic lobes (*b*) are generally of moderate size; and are placed behind the hemispheres on the same level. The Cerebellum (*c*) is, on the contrary, very small; and (as in other oviparous Vertebrata) it does not send beneath the Medulla Oblongata, that transverse prolongation or *commissure*, which aids in forming that ring around it, which is possessed by Mammalia. The Spinal Cord (*d*), compared with the brain, is very much developed; and it may also be remarked, that the nerves are larger in proportion to the size of the central parts of the nervous system, than in the higher animals.

FIG. 308.

471. Most Reptiles have no special organ of touch; and in general this sense cannot be very much developed, from the nature of their integuments, the skin being covered by a thick epidermic layer formed of plates more or less dense, consisting of horny or even bony matter. The substance known under the name of Tortoise-shell, and employed for such various uses, consists of the horny plates which cover the carapace of a particular species of Turtle (Fig. 318); and the majority of the Tortoises and Turtles are in like manner coated with horny matter. The epidermis is detached at different periods of the year, to make room for a new formation. Sometimes this species of moulting is partial, or, at least, the epidermis only falls off by shreds; but in other instances it is detached entire, and preserves the form of the animal by which it is thrown off. In the latter case the skin when shed presents a perfect cast of the outer surface of the animal, every mark and line upon the scales being exactly reproduced, whilst in the snakes, even the transparent skin which covers the eyes is shed. Serpents thus cast their skins at least once a year.

472. The eyes of Reptiles do not present anything very remarkable; their position is, in general, almost the same as in

Birds ; but we only rarely find a prolongation having an analogy with the *marsupium* (§. 340). The eyelids are generally to the number of three, but are sometimes entirely wanting; in Serpents, for example, the skin is continuous without interruption in front of the eyes; and only presents in this point sufficient transparency, not to oppose any obstacle to the passage of light,—an arrangement which gives to these animals a remarkable fixity of look.—The auditory apparatus is much less complete than in Mammalia, or even than in Birds. The external ear is almost always entirely wanting; and the tympanum is at the surface of the head, either uncovered, or concealed beneath the skin ; sometimes there does not exist even a trace of it. The cavity of the tympanum is usually but very imperfectly closed in by the bones of the cranium, and communicates by a large slit with the pharynx, of which it sometimes seems to be only an appendage ; the small bones of the ear are generally wanting ; and the cochlea is often rudimentary.—The nasal fossæ are but little developed ; and the sense of taste seems to be very obtuse in all these animals. The tongue is sometimes thickened and fleshy ; but in general it is thin, dry, very protractile, and cleft towards the end ; Serpents and Lizards (Fig. 309) afford us examples of this. Lastly, in the Chameleon, this organ becomes a very remarkable instrument of prehension; for the animal can dart it out to a distance which exceeds the length of its body; and it is terminated by a kind of adhesive cushion, to which the flies and other insects, on which this slow and awkwardly-moving reptile feeds, are easily attached.

FIG. 309.

473. There are few Reptiles which live on vegetable matter alone. Almost all are carnivorous, and, with some exceptions, only seek a living prey, which they swallow generally without dividing it, sometimes even without destroying its life ; the carnivorous Tortoises and the Crocodiles alone seem to make use of their jaws in dividing their food. Hence the selection of the animals on which most Reptiles are nourished is regulated, to a certain extent, by the size of their mouth.

It is always widely dilated; but it is among Serpents, that it is susceptible of being extended in the most remarkable manner; hence, these Reptiles can swallow animals larger than themselves. The two branches of the lower jaw are not united; and the sort of pedúncle or stalk which supports them (the tympanic bone, *t*, Fig. 310,) is not only movable itself, but is also suspended to another portion of the temporal bone, called the *mastoid bone* (*ma*), which is likewise distinct from the cranium (*c*), and is attached to it only by ligaments and muscles. The branches of the upper jaw (*m*), are only fixed to the intermaxillary bone by ligaments, which permit them to be more or less separated; and the palatine arches (*p*) also participate in this mobility. This peculiarity of structure corresponds with the habits of these essentially carnivorous Reptiles. They can support abstinence for a long time; but generally, when an occasion presents itself, they take into their stomach such a great mass of nutriment, that, during their digestion of it, they remain in a state of torpidity more or less profound. They do not masticate their food, but their mouth is armed with hooked teeth, adapted to retain their prey within it.

FIG. 310.—SKULL OF RATTLE-SNAKE.

c, cranium; *ma*, mastoid bone; *t*, tympanic bone; *m*, upper jaw; *mi*, lower jaw; *n*, nasal bones; *p* and *pi*, pteregoid and palatine bones.

474. Several Serpents, such as the Viper, the Asp, the Crotalus, or Rattle Snake (Fig. 331), and the Trigonocephalus, present still more remarkable peculiarities of structure; for nature has endowed them with a venomous apparatus, by the aid of which they can immediately kill, as soon as they bite them, the animals upon which they intend to feed. Their poison is secreted by glands, which greatly resemble the salivary; and which pour this liquid out by an excretory duct, in the neighbourhood of one of the maxillary teeth of the upper jaw, whose form is modified, in order to adapt it to the uses for which it is

destined. These glands (*v*, Fig. 311) are placed under the temporal muscles, so as to be compressed by their contraction; and this tooth, which is larger than the others, is sometimes pierced by a canal, and sometimes only channelled by a furrow; but in both cases, the canal which it presents is in communication with the excretory duct of the poison-gland, and serves to convey the venom to the bottom of the wound which is made by the tooth itself. This venom is one of the most violent of poisons. It is neither acrid nor burning; it only produces on the tongue a sensation analogous to that occasioned by a fatty matter, and may be swallowed with impunity; but, introduced in sufficient quantity into a wound, it produces death with frightful rapidity. Its power varies with the species, and according to the circumstances in which the Serpent is found. The same species appears to be more dangerous in warm, than in cold or temperate countries; and the results produced by its bite are much more severe, in proportion as the poison flows more abundantly into the wound. Further, these animals are much more formidable, when they have fasted some time, and when their venom is collected in a considerable quantity in the glands in which it is secreted; than when they have bitten several times, and there can only remain a small quantity of this liquid. It has also been remarked, that their bite does not act in the same manner upon all animals. It appears that to Leeches, Slugs, the Asp, the Common Snake, the Slow-worm, &c., the venom of the Viper is not a poison; whilst it produces death with great rapidity in all warm-blooded animals, Lizards, and the Viper itself. In general the quantity of venom necessary to produce death is, other things being equal, in proportion to the size of the animal wounded; thus whilst a hundredth of a grain of the venom of

Fig. 311.—Poison Apparatus of Rattle-Snake.

v, poison gland, whose duct terminates in the large movable tooth, *c*; *m*, muscles which elevate the lower jaw, and serve also to compress the gland; *s*, salivary glands; *n*, nostrils.

the Viper is sufficient to kill a Sparrow, six times as much would be required to destroy a pigeon.

475. Before this poison can act upon the animal body, it must be absorbed and carried into the current of the circulation; hence, when a bite has been received from a venomous reptile, the most proper means to retard this absorption should be at once employed, in order to have time to draw out, or to destroy, the venom deposited in the bottom of the bite. Compression exercised upon the veins above the bitten part, and the application of a cupping-glass upon the wound itself, are the most proper means to retard the absorption of the poison; but in order to deliver the sufferer completely from the danger which menaces him, it is necessary in general to enlarge the wound, and to cauterise the bottom of it, either with a red-hot iron, or with powerful caustics. Some internal remedies have also been praised, such as ammonia, arsenic, &c.; but on these means, even if they are sometimes useful, no great dependence should be placed. The South American Indians attribute still greater virtues to a plant of their country, known by the name of *Guaco*, or *Micania guaco;* they assert that not only does the application of the leaves of the guaco upon the bite of the most dangerous Serpents, prevent all deleterious effect, but that the inoculation of the juice of this plant prevents these animals from biting the person thus prepared. The celebrated and learned traveller, M. de Humboldt, thinks, after some experiments, that the guaco may give to the skin an odour which is repugnant to the Serpent, and which hinders it from biting. The symptoms which accompany the action of the poison differ according to the species and circumstances. Generally, the circulation is extremely enfeebled, the blood loses the power of coagulating, and the parts surrounding the wound become gangrenous.

476. The arrangement of the poison-apparatus varies amongst these Reptiles. Sometimes the tooth which is placed at the end of the canal that excretes the poison, is a movable hook; sometimes an immovable tooth, simply furrowed.—*Serpents with movable poison fangs*, are the most dangerous. These fangs

(Fig. 311, *c*) situated in the front of the mouth, are separate from the rest, very sharp and pierced by a small canal, which terminates near their extremity; they are fixed upon very small maxillary bones (Fig. 310), and these bones, supported upon a long pedicle, are very movable; so that when the animal does not intend to use these poison-fangs, it turns them backwards, and conceals them in a fold of its gum, from which it can erect them at any moment. One of these long teeth is seen on each side; and there are, behind each of them, several germs, destined to replace it, if it should break in the act of biting; but the maxillary bones do not bear any other teeth; and there are only seen in the roof of the mouth, two rows of palatine teeth, instead of four ranges, as in the common Snakes. These last animals, like several other Reptiles have the palate furnished with teeth, as well as the jaws.—Some Reptiles are, on the contrary, completely destitute of teeth; such as the Tortoises, in which the jaws are covered with a horny plate, having cutting edges, and bearing a considerable resemblance to the beak of Birds; but there are never fleshy and movable lips like those of Mammalia.

477. As the aliment does not require to remain in the mouth, in order to be ground down there, the veil of the palate would have been in general useless; and in fact, it very seldom exists. In the greater number of these animals, the pharynx is not distinct from the mouth, and frequently there is not even any well-drawn line of separation between the œsophagus and the stomach, which is simple and of varied form. The intestines are short and deprived of the cœcal appendage; the large intestine differs little from the small intestine, and terminates in a *cloaca*, into which open also the urinary canals and organs of reproduction.—Reptiles have, like the higher animals, lymphatic vessels, destined to absorb the products of digestion, and to pour them into the current of the circulation.

478. Their blood is not rich in solid matter; and the oval corpuscles, which swim about in it, are of a greater size than in any other class. The arrangement of the circulating system varies; but there is always a direct communication between the

system conveying arterial blood, and that conveying venous blood; so that these two liquids mingle, and the body only receives blood which has been imperfectly arterialised by the act of respiration. The heart is almost always composed of two auricles (Fig. 312), opening into a single ventricle. It follows from this

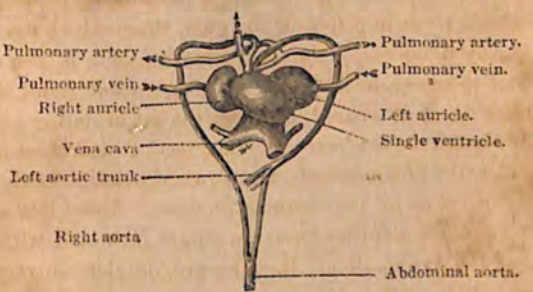


FIG. 312.—HEART OF TORTOISE.

that the *arterial* blood coming from the lungs, received into the *left* auricle, and the *venous* blood flowing from the different parts of the body into the *right* auricle, are mixed in this common ventricle. One portion of this mixture returns by the aorta to the different organs, which it is destined to nourish; whilst the other part is carried to the lungs by vessels which arise directly from the common ventricle, or even from the aorta. In Crocodiles, however, the heart is formed (Fig. 313) almost in the same manner as in Birds and Mammalia, and presents a partition which separates the right from the left ventricle; it follows, therefore, that this organ presents two distinct ventricles and two auricles, and that the arterial blood is not mixed there with the venous blood; but a particular arrangement of the arteries effects this mixture at some distance from the heart, and the vessels of all the posterior half of the body only receive imperfectly-arterialised blood. In fact, the venous blood received into the right ventricle does not go entirely to the lungs, as in warm-blooded Vertebrata; for, at the side of the opening of the pulmonary arteries (*ap*), is found another vessel (*a*) which likewise arises from the right ventricle, and which, after bending back

toward the heart, goes to empty itself into the descending aorta (*ao*)

FIG. 313.—HEART AND LARGE VESSELS OF CROCODILE.

vv, systemic veins, terminating in the right auricle, *od*; *vt*, the two ventricles, separated by an internal partition; *ap*, the two pulmonary arteries, conveying blood from the right ventricle to the lungs; *a*, trunk from the same ventricle, going to join the descending aorta; *vp*, pulmonary veins, emptying into left auricle, *og*; *ao*, aorta, arising from left ventricle; *c*, *c*, vessels proceeding to the head.

It follows from this, that at each contraction of the heart, one portion of the venous blood is carried to the lungs, and another portion goes to be mixed with arterial blood; but this mixture is not carried on in the first part of the interior of the aorta, but below the origin of the branches (*c c*) which this vessel sends to the head and anterior part of the body, so that these parts receive pure arterial blood; whilst all those parts, whose arteries arise below the point of junction of the aorta, with the vessel arising from the right ventricle, only receive a mixture of red and dark blood.—With respect to the mode of distribution of the arteries among Reptiles, we shall only add, that there exist two or more aortic arches curving to the right and to the left, and shortly uniting to constitute one trunk (Fig. 314).

479. The respiration of Reptiles is not active; the greater number of these animals consume but little oxygen, and can be deprived of it for a long time without being suffocated. Moreover, temperature has very great influence upon this phenomenon; and in warm weather, the necessity of respiration is felt much more than in winter. The lungs are organised in a manner which is not favourable to a great activity of their functions; for their air-cells are very large, and consequently the vascular surface destined to receive the contact of the air is of small extent (ANIM. PHYSIOL., § 312). They are not lodged in a distinct cavity; the thorax not being separated from the abdomen by a diaphragm; and the air is renewed in their interior with less facility and regularity than in the higher animals. Sometimes even, as in Tortoises, the absence of the ribs, or the immobility of these bones, renders

the ordinary respiratory movements impossible; and then it is

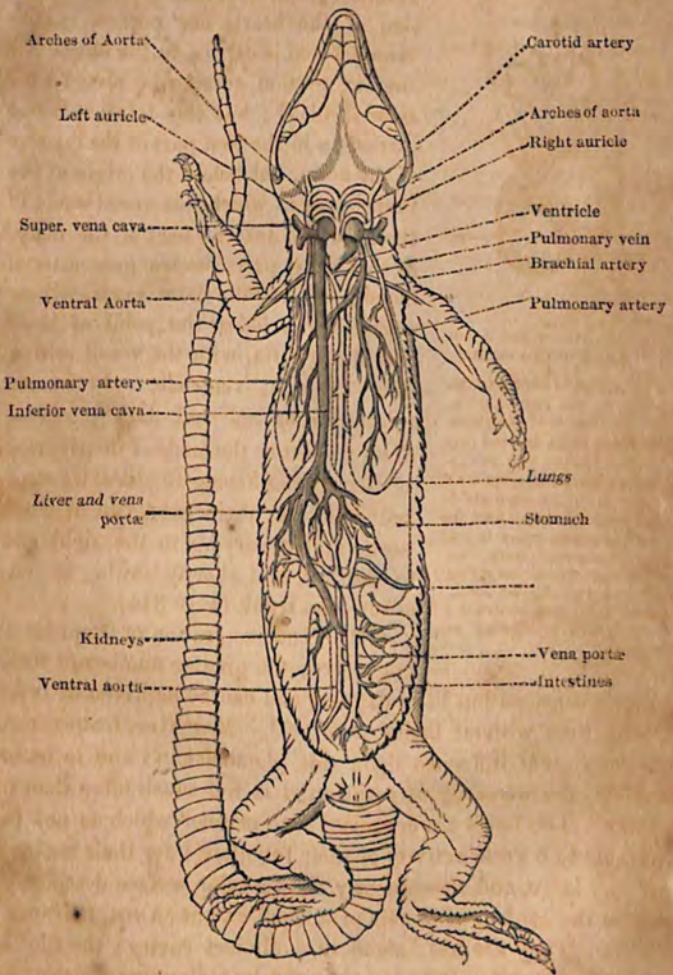


FIG. 314.—CIRCULATING APPARATUS OF LIZARD.

by an act of deglutition, that the air is forced into the lungs. It is likewise to be noticed, that Serpents present, in the arrange-

ment of the respiratory apparatus, a remarkable anomaly; one of their lungs being so little developed, that we can often scarcely

FIG. 315.—ANATOMY OF COLUBER.

l, tongue and glottis; *œ*, œsophagus, divided at *œ'* to show the heart, &c.; *i*, stomach; *i'*, intestine; *cl*, cloaca; *an*, anus; *f*, liver; *o*, ovary; *ô*, eggs; *t*, trachea; *p*, principal lung; *p'*, undeveloped lung; *vt*, ventricle; *c*, left auricle; *c'*, right auricle; *ag*, left aortic arch; *ad*, right aortic arch; *â. â*, ventral aorta; *ac*, carotid arteries; *v*, vena cava superior; *vc*, vena cava inferior; *vp*, pulmonary vein.

perceive it; whilst the other acquires very considerable dimensions (Fig. 315).

480. Reptiles are all cold-blooded animals; that is to say,

they do not produce enough heat to have a temperature sensibly higher than that of the surrounding air. The whole of their body is heated or cooled at the same time as the surrounding medium; and the changes of temperature which they thus experience have great influence upon all their functions. A warmth of from 105° to 120° is soon fatal to most of these animals; and cold tends to depress all their vital operations. In winter most of them could no longer digest the food introduced into their stomach, and do not take nourishment. Their respiration also diminishes in a most remarkable manner.

481. Like Birds, Reptiles are destitute of mammæ for the suckling of their young, and are reproduced by eggs; but these eggs are sometimes hatched before they come out of the body (in the Viper, for example); and the name of *ovo-viviparous* is given to the animals in which this phenomenon is observed. The eggs of Reptiles are always of large size, and usually enclosed in a shell of the consistence of parchment, in which, however, a small quantity of calcareous matter is sometimes contained.

The animals generally deposit their eggs in warm sandy places, where they abandon them to be hatched by atmospheric warmth only; but as the eggs are commonly retained within the body of the parent until the development of the embryo has proceeded a considerable length, they are not exposed for any time to the dangers of such a situation. Some species, however, such as the Crocodiles and some Lizards, are said to watch over their eggs until the exclusion of the young; and a large Indian Serpent, nearly allied to the *Boas*, known by the name of *Python*, twines itself round its eggs; and whilst it remains rolled round its offspring, it gives out such a considerable amount of heat, that the temperature of its body is sometimes raised to more than 104° Fahr.

482. The class of Reptiles may be most naturally divided into the four following orders, the differences between which are very obvious and important.

I. Chelonia, or *Tortoises;* in which the trunk is enclosed between a *carapace* and *plastron* (§ 464) formed by the dorsal vertebræ, ribs, and sternum, with the assistance of the dermal

skeleton; the mouth destitute of teeth, but furnished with a horny beak; the skin covered with large horny plates; and the members, four in number, all formed upon the same plan.

II. LORICATA, or *Crocodiles;* Lizard-like Reptiles, with the skin covered with bony plates; toothed jaws; four complete members; and the external aperture of the cloaca forming a longitudinal slit.

III. SAURIA, or *Lizards;* in which the dorsal vertebræ and ribs are movable, so that there is neither carapace nor plastron; the jaws are toothed, and the tympanic bone fixed; the skin is covered with *horny* scales and the cloacal aperture is transverse. Limbs usually four.

IV. OPHIDIA, or *Serpents;* which are formed upon the same general plan as the Lizards, but have the tympanic bone movable, and are always destitute of limbs.

As the chief peculiarities of these several orders have been already noticed, a very short account of some of the principal families included in them will suffice.

ORDER I.—CHELONIA.

483. The animals composing this order vary considerably in those details of their structure, which adapt them to different habits of life; some of them being destined to reside exclusively upon the solid ground, others to pass nearly their whole time in water, and others to dwell amidst marshes, the muddy banks of rivers, &c. The most obvious variations are in the structure of the feet, and in the form of the shell. Thus in the proper *Land-Tortoises*, we meet with a short stumpy foot, not unlike that of an Elephant,—the toes not being separated, and only the claws apparent (Fig. 316.) In the *Marsh* and *River-Tortoises*, the toes are divided and webbed, so as to increase the extent of surface; and in the *Marine-Tortoises*, or *Turtles*, we find them extended into large undivided paddles, by which the animals can propel themselves rapidly through the water (Fig. 318).—

The *carapace* is highly arched and very strong in the Land-Tortoises (Fig. 316); but more flattened in the aquatic families, for the better adaptation of their form to motion in a liquid. The *plastron* differs considerably in degree of development, and in the relative consolidation of its different parts. It is most complete in the Land-Tortoises; in many of which, the anterior and posterior portions of it are so jointed to the centre-piece, as to be able to close the orifices before and behind, after the head, tail, and legs have been drawn in,—thus affording to the animal a most excellent means of *passive defence*. The natural food of many of the Chelonia is vegetable, and they can endure long fasting with impunity; there are some species, however, which are carnivorous, and which show much ferocity of disposition. They are extremely tenacious of life; surviving the severest mutilations for days or even weeks. Their movements are usually slow and awkward; but they continue them with great perseverance, and for a long time, apparently without fatigue, so as to produce effects which would not have been anticipated. Their sensations appear to be very obtuse; and altogether they may be said to *live very slowly*. Connected with this slowness appears to be the remarkable *length* of their lives; which has been known to exceed (in the case of a Garden Tortoise) two hundred and twenty years, and may have been much more.—The Chelonia are divided, according to the form of their shell and extremities, into five families:—1. TESTUDINIDÆ, or *Land-Tortoises*;—2. EMYDIDÆ, or *Marsh-Tortoises*;—3. CHELYDIDÆ, or *Frog-Tortoises*;—4. TRIONYCIDÆ, or *River-Tortoises*;—and 5. CHELONIDÆ, or *Turtles* (Marine Tortoises).

484. The TESTUDINIDÆ are slow, quiet, inoffensive animals; feeding upon vegetable substances, and seldom wandering far from their usual haunts. They are for the most part inhabitants of the warmer regions of the globe; though many species will bear removal to colder climates,—passing the winter, however, in a torpid state. The *Testudo Græca*, of which the upper and under surfaces are shown in Figs. 316 and 317, is the species best known in this country; it is a native of the South of Europe; but it will live in our gardens for many years

without any particular care. It digs a pit in the ground, in which to hybernate; and it also buries its eggs in the soil,

FIG. 316.

FIG. 317.

lightly covering them with earth. Some very large species of this group are found between or near the tropics. Thus the Galapagos Islands are inhabited by great numbers of gigantic Tortoises, weighing above two hundred pounds each; which are described as wholesome and palatable articles of food. Mr. Darwin, who has given an interesting account of these animals, tells us that on catching a Tortoise, the captor makes an incision in its skin near the tail, to see whether there is a thick layer of fat under the dorsal plate. If not, the animal is allowed to go again, and appears to be but little incommoded by the operation. The inhabitants of these Islands also put the Tortoises to a still more curious use. The springs are always situated in the centre of the Islands, and at a considerable elevation, and the Tortoises which live in the lower districts are compelled, when in want of water, to travel up to the springs to lay in a stock of that fluid. After a visit to the springs, the bladder is found filled with a very pure water; and the inhabitants of the low country, when overcome with thirst, kill a Tortoise, and drink the water contained in the bladder. This species appears to be identical with the *Indian Tortoise*, and grows to a very large size. In the gardens of the Zoological Society in the Regent's Park there was, a few years ago, a specimen of this Tortoise, which mea-

sured four feet four inches along the curve of the back, and four feet nine inches in breadth, and weighed two hundred and eighty-five pounds. It was originally brought to the Mauritius from the Seychelles Islands in 1766.—The EMYDIDÆ, or *Marsh Tortoises*, form an extensive family, diffused through the warmer latitudes of both the Old and the New World. They have a more flattened shell, of which however the carapace is completely ossified; the head and neck can usually be entirely retracted within the shell; and their feet are expanded and webbed between the toes, four or five of which on each foot are armed with sharp claws. These animals tenant swamps, lakes, ponds, and small rivers; and swim with considerable facility. On land they are more active and alert than the species of the previous family; but they never venture far from the water, and invariably seek it as a refuge from danger. The plastron is generally less developed than in the Testudinidæ, and is frequently united to the carapace by cartilage only: in some species, as the *Chelydra serpentina*, the carapace and plastron are so small, that the head and limbs cannot be drawn within the shell. In the *Box Tortoises*, on the contrary, the plastron is divided by a transverse suture into two parts, which are movably attached to the carapace; so that the creature can not only withdraw its head and limbs beneath the roof formed by the dorsal shell, but can also close its habitation completely, as if by a front and back door. The Emydidæ are carnivorous in their habits; pursuing fishes, newts, frogs, and insects with eagerness. Some of them are formidable from their size and ferocity; this is the case with the species above named, which is commonly known under the name of the *Alligator Tortoise*. It is a native of the lakes, rivers, and morasses of Carolina; and is remarkable for its activity, and for the strength of its jaws,—darting suddenly upon aquatic Birds, Fishes, or other animals that come within its reach, and snapping them up between its mandibles. It cannot be safely approached even by Man.—The CHELYDIDÆ, in their general form and the structure of the feet, agree with the Marsh-Tortoises, but the carapace is imperfectly ossified, and the head and limbs are not completely retractile. The mouth also is sur-

rounded by soft lips, the nose usually elongated into a proboscis, and the head and neck often furnished with lobes and appendages of very curious forms. In their habits these Tortoises agree with those of the last family; they frequent the ponds and rivers of the warm parts of both hemispheres, feeding principally upon Fish. A few species are even found in Australia, where they are the only representatives of this order.

485. The two other families of this order are almost exclusively aquatic; coming on shore only to deposit their eggs, and doing this stealthily by night. In the TRIONYCIDÆ, or *River Tortoises*, however, the structure of the feet does not depart so widely from the forms of the preceding families as it does in the Turtles; for although the toes are connected by a web, and only three of them are furnished with claws, they are still distinguishable. Like the Emydidæ, these Tortoises are exclusively carnivorous; and they eat their food in the water. They subsist upon Fishes, Reptiles, Birds, &c., upon which they dart out from their hiding-places, and snap at their prey with great energy and rapidity. The edges of their mandibles are so sharp and firm, that they can readily bite off a man's finger. From this vigorous action of the jaws the best known species has received the name of the *Snapping Turtle*. The ossification of the carapace is very imperfect; the costal plates are only broad and united towards the centre of the shell, and become narrower towards the circumference, radiating like the spokes of a wheel; the plastron also is imperfectly ossified; and instead of the hard horny plates of the preceding families, the carapace is covered with a tough leathery skin. Hence these animals are sometimes called Soft Tortoises. No species of this family is European; but almost every large river and lake, in the warmer regions of the Old and New World, is inhabited by them. They are particularly numerous in the Ganges; where they prey, with the Gavials, on the human bodies which are always floating in that stream.—The *Snapping Turtle* above referred to, is abundant in the fresh waters of North America, where it devours great quantities of young Alligators; and another species inhabiting the Nile, is said to be equally destructive to the Crocodile.—The

Marine Tortoises, CHELONIDÆ, or *Turtles*, are at once distinguished by the compressed and paddle-like form of the feet; of these, the anterior pair is most developed; and they are used as oars, or rather as aquatic wings, by means of which these animals can move through the water in any direction, with considerable rapidity and address. This conformation, however, renders their progression on land so much the more difficult; they can only shuffle along at a slow rate and with laborious efforts; and, from the flattened form of their carapace, they are unable to recover their natural position, when turned upon their backs upon a flat surface. The jaws of the Turtles are robust; and the upper mandible is received into a groove in the lower, so that their grasp is very firm. Most of the species feed upon marine plants; but the *Hawksbill* (Fig. 318), so named from the peculiar hooked form of the end of the upper mandible, also eats Crustacea, Shell-fish, Echini, &c. These animals are found in all the seas of warm climates, but principally in the tropical ocean; though stragglers occasionally arrive at our own shores. They have their favourite breeding-places, to which thousands periodically resort, often travelling thither from immense distances; these are usually islands situated in the midst of the open ocean,—such as the island of Ascension, which is one of those most frequented by them. At other times they are found at the distance of many hundred leagues from any land.—The species most valued as food is the *Chelonia midas*, or *Green Turtle;* this occasionally attains an enormous size, measuring six or seven feet in length, and weighing from five to eight hundred pounds; its ordinary bulk, however, is much less. —The *Chelonia imbricata*, or *Hawksbill Turtle*, is the one most in request for its covering of horny plates, which are known as *tortoise-shell;* these plates are of

FIG. 318.—HAWKSBILL TURTLE.

large size, and lie over one another like the tiles of a house, so that each is overlapped by the one in front of it, to one-third of its extent. Hence, although this species is not nearly so large as the Green Turtle, the plates are of greater dimensions, as well as of finer quality. Its flesh, however, is neither so palatable nor so wholesome.—One other species may be noticed, the *Sphargis*, or Leathery Turtle; which differs from all other Turtles, in having the bones covered with a leathery skin, instead of with plates. When attacked and wounded, it utters loud piercing cries, which have been heard nearly a mile off. It sometimes attains enormous dimensions; the occurrence of specimens measuring about eight feet in length, and weighing one thousand pounds, being recorded. Its flesh appears to be very unwholesome.

486. Little is as yet known of the fossil forms of this order; but, from discoveries made some years since among the Himalaya mountains, it appears that Tortoises must have formerly existed, far surpassing in dimensions the most bulky of the Chelonidæ now living. The *Colossochelys Atlas*, discovered in the Sewalik hills by Falconer and Cautley, measured about eighteen feet in length; and it seems not improbable that, like the *Dinornis*, it may have existed down to the human era.

Order II.—LORICATA.

487. The animals forming this order, the Crocodiles and Alligators, are placed by some naturalists with the Lizards, with which, in fact, they agree in external form, and, to a considerable extent, also, in general structure. They are, however, in some particulars of their organization, decidedly superior to other Reptiles;—their heart possessing four cavities (§ 478), and their lungs being more subdivided than those of Reptiles in general. Unlike the Lizards, the palatine bones form a complete roof to the mouth; and are destitute of teeth. The jaws are long, and the tympanic bone, to which the lower jaw is articulated, although firmly attached to the head, projects backward beyond

the skull; so that the gape of the animals is of enormous width. The lower jaw itself is composed of six pieces on each side, the foremost of these constituting the greater part of the jaw, and being alone furnished with teeth; these are conical and acute, and inserted into the jaws by regular sockets. The nostrils are placed at the extremity of the snout, and capable of being closed by a valve, to prevent the ingress of water. The tongue is fleshy and fixed to the bottom of the mouth; and the eyes, which are of considerable size, have contractile pupils, which form a perpendicular line when exposed to daylight. The lungs do not penetrate into the abdomen, as in other Reptiles; and there is even a trace of a diaphragm separating the thoracic and abdominal cavities. The dermal skeleton consists of large, square, bony plates imbedded in the skin, protecting the dorsal surface; and these are often of peculiar forms in different regions of the body, when they furnish excellent characters for the discrimination of the species. These animals, as is well known, are very ferocious in their disposition; they seize their prey for the most part in the water, but retire to some retreat on land to devour it; and they relish it in a state of putrescence. Their aquatic habits are indicated by the vertical flattening and expansion of the tail, and by the webbing of the posterior feet; in this respect, however, there is a difference between the several groups of this order. They are only found in warm climates; and inhabit the rivers, lakes, and marshy places; sometimes swimming out to sea, even to a considerable distance from land.

488. In the recent species of this order, the bodies of the vertebræ have the posterior surface convex, and the anterior concave; they form the single family CROCODILIDÆ. They may be divided into two principal groups,—the *Crocodiles*, which are common to both hemispheres; and the *Alligators*, which are peculiar to America. The *Crocodiles* have the hind feet webbed nearly or quite to the extremities of the toes, and the long teeth, commonly called *canines*, which occur on each side of the lower jaw near the front, are received into a *notch* in the upper jaw; in the *Alligators*, the hind feet are never completely webbed, and the lower canine teeth fit into a *pit* in the

upper jaw. The Crocodiles also have a ridge of projecting scales down the outer border of their hind legs, which are wanting in the Alligators. The Crocodiles, again, are divided into the *true Crocodiles* and the *Gavials;* of the latter only one living species is known. This is the *Gavial*, or Gangetic Crocodile, which is distinguished by having the jaws produced into a long, narrow, cylindrical muzzle, terminated by a cartilaginous protuberance, in which the nostrils are situated, and which is particularly developed in the male. The Gavial is aquatic in its habits; its hind feet are fully webbed, and the crest of projecting plates on the tail, increasing the surface by which it strikes the water, is much elevated. This powerful animal frequently attains the length of twenty-five feet, and is very formidable from its strength and ferocity. It is very serviceable in devouring the numerous dead bodies of men and animals which are committed to the sacred river, and which would otherwise taint the air by their decay. The true *Crocodiles* are inhabitants of Africa, India, and the hotter parts of America. Their muzzle is more elongated than that of the Alligators, but much less so than in the Gavials; and

FIG. 319.—CROCODILE.

the three outer toes of the hind feet are entirely webbed. The movements of these animals on land are awkward, the legs being ill formed for running, and the head possessing but little power of motion from side to side; but in water they dart along with great rapidity, by the lateral movements of the tail, aided by the action of their swimming-feet.—The *Alligators*, or *Caymans*, are confined to America, and are less aquatic in their habits than the Crocodiles. They frequent swamps and marshes, rather than rivers; and are occasionally seen basking on dry ground, during the day, luxuriating in the heat of the sun. It is during the night that they are most active; and they then set up a loud

bellowing, not unlike that of a bull. At the approach of winter the North American species bury themselves in holes in the earth, and pass the cold weather in a state of torpidity. Several species of Alligator are known; varying in length from two to more than twenty feet.—Several species of Crocodiles are found in a fossil state; some of them having been much larger than any now existing. It is interesting to remark, that remains of forms allied to the Gavials are found in the same strata with those of the Ichthyosaurus and Plesiosaurus; which strata are, geologically speaking, much older than those in which the remains of Mammals occur. It is in these last that we find relics of Sauria resembling the Caymans of the present time; and this is in accordance with the general rule, that the *terrestrial* animals were the last to make their appearance on the surface of the globe. Some of the fossil Crocodiles belong to the same family as the existing species, having the posterior surface of the bodies of the vertebræ convex; whilst others, such as the *Steneosaurus*, had the convexity on the anterior surface, and the gigantic *Teleosaurus* had both surfaces concave, like those of the ordinary fishes.

489. In the Jurassic strata, in which the most remarkable of these extinct Crocodiles first make their appearance, we also meet with the remains of numerous gigantic Reptiles, which appear to have been most nearly related to the Crocodiles, although they had smooth skins, quite destitute of the bony plates characteristic of the *Loricata*. They have been formed by some naturalists into a distinct order, under the name of ENALIOSAURIA. Of these the ICHTHYOSAURI, or *Fish-Lizards*, from their whole organization evidently hold an intermediate position between the Reptiles, Fishes, and Cetaceous Mammalia. The spinal column is formed upon the plan of that of a Fish; the vertebræ being concave on both surfaces, and having had a bag of fluid interposed between each pair (§ 66); and the arches which enclosed the spinal cord always remained distinct from the bodies. Hence the body must have had great flexibility, and must have been able to move rapidly through the water by its undulations from side to side, assisted probably by a broad fin-like expansion of the

tail; whilst the spinal column could not have been sufficiently strong to support the weight of the trunk upon land. But the progression of these animals through the water was accomplished in part by means of the anterior and posterior extremities, which

Fig. 320.—Ichthyosaurus.

are very efficient instruments of propulsion, being formed very much upon the plan of the paddles of the Whale; but the number of fingers and phalanges was much greater; and the bones themselves, being shorter, were arranged in a tessellated manner. The muzzle is elongated and pointed; and the teeth very numerous. The general form of the head is not unlike that of the Porpoise; but it must have had far greater strength, and the surface for the attachment of muscles is very extensive. The form and solidity of the sternal arch, to which the anterior paddles are attached, show that provision was made for imparting enormous power and firmness to these; and certain peculiarities in the structure of the tail seem to prove, that the Ichthyosaurus must have had a vertical cartilaginous tail-fin, like that which is seen on the back of many Cetacea. From the absence of any remains of scales or plates, it may be concluded that the skin was naked, like that of the Whales and their allies. There is no question that the Ichthyosaurus was exclusively an air-breathing animal; no trace of any adaptation to branchial respiration being perceptible. From the remains of partially-digested food, which are found with their bones, it appears that they fed (as might have been anticipated) exclusively upon Fishes; and especially upon one species, which is known only in a fossil state. Some of the largest of these aquatic Reptiles must have exceeded thirty feet in length; and it is easily to be conceived that they were very formidable enemies to the other inhabitants of the deep. They seem to have taken the place of the Gram-

pus, and other voracious Cetacea, at a time when no Mammals had been called into existence.

490. Still more extraordinary in its conformation, was the animal known under the name of the *Plesiosaurus;* which has been designated by Cuvier as the most *heteroclite*,—that is, made up of the most unexpected combination of parts,—of any that had come under his knowledge. To the head of a Lizard

FIG. 321.—PLESIOSAURUS.

it united the teeth of a Crocodile; a neck of enormous length, resembling the body of a Serpent; the trunk and tail having the proportions of an ordinary Quadruped; the ribs resembling those of the Chameleon; and the paddles being like those of the Whale. "Such," says Dr. Buckland, "are the strange combinations of form and structure in the Plesiosaurus; a genus, the remains of which, after interment for thousands of years, amidst the wreck of millions of the inhabitants of the ancient earth, are at length recalled to light by the researches of the geologist, and submitted to our examination in nearly as perfect a state as the species that are now existing upon the earth." The Plesiosaurus was evidently a marine animal; and, if ever it visited the land, its motions must have been very awkward. The probability is, that it swam habitually on or near the surface of the water, arching back its long neck like the Swan, and occasionally darting it down at the fish which happened to float within its reach. Or it may have lurked in shoal water along the coast, like the long-necked Emydidæ of the present time (§ 484); suddenly darting at such fish or reptiles as approached its place of concealment. The neck had no less than forty vertebræ in some species; a greater number than exists in any other known animal, the Swan having but twenty-three.

Order III.—SAURIA.

491. The number of species included in this order is very considerable; and their variation in form, dimensions, and character, is far greater than is to be met with in the preceding groups. The contrast is still more striking when we include in our survey those fossil remains of Saurian Reptiles which abound in many parts of the world; for great as may be the difference in size and appearance between many of the existing Lizards, it sinks into nothing in comparison with that between any living forms and the monstrous Saurians of the ancient marshes and waters, or the Pterodactyles, which are supposed to have winged their Bat-like way through the air. The diversity in the habits of the existing Saurians is very considerable; a few are more or less aquatic; others strictly terrestrial, living on the ground, and retreating for shelter to holes burrowed beneath the surface; whilst others are entirely arboreal, passing their whole lives amongst the branches of trees. They mostly feed on animal substances; some preferring flesh, and others devouring insects and worms; one family is almost exclusively herbivorous. They are all furnished with teeth, which are of a simple conical form, and adapted rather for securing and tearing their food than for masticating it. The principal families included in this order are the following:—1. Chamæleonidæ, or *Chameleons*;—2. Geckotidæ, or *Geckos*;—3. Iguanidæ, or *Iguañas*; 4. Agamidæ, or *Agamas*;—5. Varanidæ, or *Monitors*;—6. Ameividæ, or *Tejuexins*;—7. Lacertidæ, or *True Lizards*;—8. Chalcidæ, or *Snake-Lizards*;—9. Scincidæ, or *Skinks*;—and 10. Gymnophthalmidæ, or *Naked-eyed Lizards*. The first four of these families have the tongue thick and fleshy, whence they are called *Pachyglossa*, or *Thick-tongued Lizards*; in the remainder, this organ is slender, bifid, sheathed, and capable of being protruded without the mouth being opened; these are called *Leptoglossa*, or *Slender-tongued*. Besides the above families there are two which appear to unite the Lizards with the Snakes, and which

are sometimes placed with the one and sometimes with the other of these orders by different naturalists.

492. The family CHAMÆLEONIDÆ, or *Chameleons*, is distributed through the warmer parts of the Old World, but not in America. The species it includes are distinguished from all others, by several very remarkable peculiarities. Their bodies are much compressed, or flattened sideways; and the back is surmounted by a sharp ridge. Two of the toes are directed backwards, opposing the three anterior ones, and thus forming very efficient instruments of prehension. The tail also, which is of a tapering form, is prehensile. The tongue is a hollow

FIG. 322.—CHAMELEON.

tube, with a swollen fleshy extremity; and it is capable of being darted out instantaneously to a great distance, and of being as rapidly drawn in. This organ is furnished with a glutinous saliva; by which the insect prey, that serve for the support of these extraordinary Reptiles, are attached to it. The eyes of the Chameleon are capable of being moved independently of each other; and they are constantly covered with a sort of eyelid, in which there is a small aperture corresponding with the pupil. Its skin is not furnished with scales, but is beset with horny granules. It undergoes, as is well known, remarkable changes of colour; varying through different shades of yellow, red, gray, brown, violet, and dull inky blue. This curious change is said to be effected in the following manner. Beneath the epidermis there is an immense number of minute, variously-coloured granules, which become more or less extended, and change

their position, in proportion to the amount of blood which is thrown into them, and thus bring the different colours into view. The change generally takes place either in consequence of variations in the temperature, or the amount of light to which the animal is exposed, or from its being irritated or alarmed; and any of these causes may be sufficient to influence the cutaneous circulation. These curious animals are arboreal in their habits; traversing the twigs and branches in a slow and cautious manner, with the aid of the grasping powers of the feet and tail; and occasionally darting out their tongues at insects that come within their reach, with such rapidity that the movement is scarcely perceptible. They are very inanimate in their appearance, often remaining in precisely the same position for many hours together; and they can exist for several months without food. The lungs are large, and are connected (as in Birds) with air-cells that lie among the muscles and beneath the skin; hence the appearance of the animal varies greatly, according as these cavities are full or empty,—being sometimes full and bloated and the next minute lean and shrunken.

493. The GECKOTIDÆ, or *Geckos*, are Lizards of small size, but of repulsive aspect; their bodies being flattened, and their

FIG. 323.—GECKO.

colour lurid. Many of the species are considered as poisonous by the inhabitants of the countries in which they are found; and some even assert that they infect every substance over which they walk; but both these opinions are, to say the least, very

doubtful. From the peculiar structure of their toes (§ 467), they are capable of running along the smoothest surfaces, of creeping up walls, and even of traversing ceilings,—like a fly,—with the back downwards: they lurk in the chinks and fissures of walls and trees, and in holes and crannies of buildings. From the flatness and flexibility of their bodies, they are capable of insinuating themselves into the smallest crevices; and there they lurk during the day, coming forth at night in quest of their insect prey, and pursuing it with much activity,—occasionally uttering a kind of chuckling cry, from which their name is derived. The Geckos are diffused through the warmer regions of all quarters of the globe; being most numerous in the tropical portions of Africa.

494. The family IGUANIDÆ, or *Iguanas*, is a very extensive one; numbering upwards of 150 species, many of which are among the largest Saurians at present existing. Of the true *Iguanas*, which are restricted to America, the general aspect will be seen from the accompanying figure. They have a crested

FIG. 321.—IGUANA.

ridge along the back; and a curious dewlap, formed by a fold of the skin, under the throat, which is capable of being distended with air. The tail is long and flexible, and is laterally compressed, as in the Crocodiles. The Iguanas are chiefly distinguished by the form and insertion of the teeth; these are not lodged in distinct sockets, but are fixed along the internal face of the jaw-bone in a sort of furrow, and adhere by one side of the bony substance of the root; the surface of the teeth is irregular, adapting them to grind down the vegetable substances on

which these animals feed. They are arboreal in their habits, and feed principally upon vegetable aliment; it appears, however, that they will sometimes eat eggs, or other animal substances. Their disposition is rather fierce, and they will defend themselves with vigour; when water is near, they betake themselves to it, and swim with considerable rapidity, by the lateral strokes of the tail. Many of them, indeed, seem to be semiaquatic in their habits, and one singular species, the *Amblyrhynchus cristatus*, inhabiting the Galapagos Islands, lives principally in the sea, and is never seen to go further on land than the rocks of the coast. The colour of the Iguanas is usually a mixture of green and brown,—adapted to conceal them during their residence in trees; and their hues seem to have some of that power of change, which is so remarkable in the Chameleons. The usual length of the common *Iguana* is from four to six feet, including the tail. The flesh is very palatable, and is much esteemed in the West Indies as an article of food; the animals, however, are now becoming scarce in most of the islands.—Remains of a gigantic Saurian have been discovered in the South East of England; which appears, from the structure of the teeth, to have been undoubtedly allied to the Iguanas of the present day; and which has received the name of *Iguanodon*. This animal could not have been less than 40 feet in length, and was perhaps more. Its teeth were evidently fitted—by the roughness of their surface,—and by the provision made in the arrangement of the enamel for the continued maintenance of that roughness, notwithstanding the wear of the tooth,—to grind down hard vegetable substances to a pulp; and remains of terrestrial plants have been found associated with it, showing that its habits were nearly the same as those of the existing Iguanas. It is remarkable also that in the structure of the skeleton the Iguanodons and their allies exhibited a most distinct resemblance to the Mammalia, especially to the large Pachyderms.

495. In this family are also included several other genera; of which those that have the teeth arranged on the same plan as the Iguanas, are, like them, restricted to the New World. The *Anolis* is a small, slender, active little animal; frequenting

woods and rocky places; and running, leaping, and climbing with singular address and rapidity. It is very timid and harm-

FIG. 325.—ANOLIS.

less; and when under the influence of fear or other excitement, the dewlap beneath its throat becomes inflated, and the tints of its skin change with great celerity. In the structure of its feet, it bears some resemblance to the Geckos; and, like them, it feeds chiefly on insects, although it also subsists in part upon vegetable substances. The largest species of this genus (of which several abound in the West India Islands) is not above a foot in length.—Another genus of this family has received the name of *Basilisk;* a term that was applied by the ancients to a monster, which existed only in their own imaginations, yet of which the most detailed accounts have been transmitted to us. The name was derived from a Greek word, signifying royalty; and the animal was represented as the king of the Serpents,

FIG. 326.—MITRED BASILISK.

with a regal crown upon its head, blighting the herbage with its breath, and striking dead with a glance of its eye. It was

described as being eight feet long, and as having two large scales for wings. The idea of such an animal could not have originated in the harmless little creatures to which the name is now applied; since these were not known to the ancients. But the term has been retained, on account of the crest or projection on the head by which they are characterised. The *Mitred Basilisk* is an inhabitant of Guiana, Martinique, and the tropical portions of South America. In its general form and habits, it is not unlike the Iguanas; but it is more aquatic, and swims with great address by means of the lateral motions of its finny tail.

496. The AGAMIDÆ, or *Agamas*, which are peculiar to the Old World, are in general short, thick-bodied lizards, covered with a lax skin, which is capable of being inflated with air at the will of the animals; they are frequently beset with spines, which are raised up when the skin is inflated, presenting a formidable array. One of the most remarkable of these spiny Lizards is the *Moloch horridus* of Australia. This has the whole surface covered with strong spines, and the top of the head has two very large spines; these are hollow horny cones filled with a fleshy process of the exact form of their interior. The back of the neck also is furnished with a large rounded spiny protuberance, from each side of which springs a longer spine, and altogether the appearance of the Lizard is most singular and forbidding. In many species, the general form and aspect are so Toad-like, that, were it not for the presence of a tail, they might be mistaken for that animal on a first glance. These lurk among rocks, heaps of stones, and mouldering ruins; where their dull and sombre colours protect them from observation. Others, however, have a more slender contour, longer limbs, and more flexible toes; and ascend trees with facility. Many of them are capable of changing the colours of the skin. A very remarkable species of this group, found in Australia, is distinguished by the presence of a sort of frill or ruff attached to the neck; this lies back in plaits, when the ani-

FIG. 327.—AGAMA.

mal is undisturbed; but is raised, to the extent of five inches on either side, when it is alarmed. This Frilled Lizard has received the scientific name of *Chlamydosaurus*. It measures about two feet in length, and fights boldly when pursued.

497. Besides the foregoing, some other genera belong to this family. Here we place the curious little *Draco volans* (Fig. 306), whose structure and habits have been already described (§ 468); this interesting animal is a native of the Asiatic Archipelago. To this group also belongs the *Stellio*, the different species of which are the most common Lizards of the Levant,—tenanting old walls, piles of stones, crevices of rocks, &c., and feeding upon insects.

498. The family VARANIDÆ, *Monitors*, or *Varans*, includes some of the largest of the Saurian Reptiles. It is the first family of the *Leptoglossa*, or slender-tongued Lizards, and is chiefly distinguished by having the head and belly covered with scales like those of the other parts of the body, instead of the plates which are found on those parts in the other Lizards. The scales, too, instead of being imbricated or lying over each other like the tiles of a house, are placed side by side, in such a way that they appear to form a series of rings round the body. The figure of these animals is elongated and graceful, and their actions are quick and alert. Some of them have a conical, nearly rounded, tail, which assists the animals in their rapid serpentine movements on land; whilst in others the tail is compressed laterally, and is a very efficient instrument for motion in water. The Varans are only found in the warmer parts of the Old World, tenanting desert and rocky places, and the borders of rivers; their food consists of the larger kinds of insects, as locusts, &c., eggs, birds, and small mammalia, reptiles, and fish. It is said that they unite together in packs on the banks of rivers, and seize such quadrupeds as approach unsuspectingly to drink. The Varan, or Monitor of the Nile, which is about six feet in length, is very destructive to the eggs and young of the Crocodile. Remains of much larger Reptiles belonging to this family, however, are found in the chalk and neighbouring deposits; the *Mosasaurus*, for example, which seems more allied to the Varans than to

any other group, must have been more than twenty-five feet in length. Its residence was in the sea; and its habits seem to have been exclusively aquatic.—Even this was but a pigmy, however, in comparison with the *Megalosaurus;* which, from the scanty remains of it yet discovered, may be proved to have been at least seventy feet in length,—equalling the Elephant in height, and approaching the largest Whales in bulk.

499. The family of AMEIVIDÆ, or *Teguexins*, which is exclusively American, is closely allied to the preceding; it contains some large Lizards, which have been termed *Safeguards* and *Monitors*, from the idea that they give warning by a hiss of the proximity of the Alligator,—which has also been supposed, though erroneously, respecting the Varans and Crocodiles. In their general habits, they much resemble the Varans. The *Teguexin* is a very large Lizard, measuring sometimes six feet in length. It inhabits Brazil and Guiana, and feeds upon various small animals, and also upon eggs. Its flesh is esteemed a great delicacy, but its capture is often attended with difficulty, as it runs swiftly when pursued, and when brought to bay fights fiercely for its life.

500. The LACERTIDÆ, or *True Lizards*, are bright-eyed, active, slender little animals, adorned with brilliant colours, and having nothing repulsive in their aspect or manners. They are covered above with small imbricated scales; and below with larger plates. The tongue is long and forked; and there are generally small teeth on the palate. To this group,—which is peculiar to the Old World, and most abundant in Southern Europe and Western Asia,—belong the only two species of Saurians that inhabit our own country, the *Viviparous Lizard* and the *Sand Lizard*. The former derives its name from the circumstance, that the eggs are hatched before leaving the oviduct of the female; so that the young are produced alive. It frequents thickets, heaths, and sunny banks; and several are often seen in such situations basking in the summer's sun, and watching for their insect prey. The females in particular expose themselves to as much external warmth as possible, during the time that the incubation of the eggs is going on

within them; and this is not improbably connected with the unusual development which these animals subsequently attain, in regard to the acuteness of their senses, and the activity of their muscular movements. They burrow in the ground, and retreat to their hiding-places on the slightest alarm. The average length of this species is about six inches. The *Sand Lizard* is larger than the preceding, its length varying from seven to twelve inches; two varieties of it appear to exist,—one being of a sandy-brown colour,—and the other having a mixture of green, more or less decided. The ordinary residence of this species is on sandy heaths; and though less quick and active than the Viviparous Lizard, it runs with considerable alertness. The greener variety, however, seems to frequent more verdant localities.—There is a beautiful green species, nearly allied to the preceding, which is common in the south of Europe, and which is frequently brought over to this country in cages. It soon becomes very tame in captivity, and will take flies from those with whom it is familiar. In all these Lizards the tail is extremely brittle; so that it snaps off at the slightest touch, when the attempt is made to seize them by it. Nature has provided a remedy for this accident, by giving to the animals the power of forming a new tail; this new organ has only a central cartilage, however, in place of the bones, and is often covered with scales different from those of the rest of the tail. If the tail be cracked only on one side, and not thrown off, a new tail often springs out of the crack, so that the member becomes forked. Other Lizards have a similar power of reparation.

501. In the family CHALCIDÆ, we meet with a series of forms, which presents us with a gradual transition from the order of Lizards to that of Serpents,—some of them, indeed, having been placed by many Naturalists in the latter. The body is usually cylindrical, and extremely elongated or snake-like; sometimes destitute of limbs, and mostly with the limbs only a little developed: there is usually no distinct neck between the head and trunk; and the latter merges imperceptibly into the tail. The accompanying figure represents the Four-toed *Sau-*

rophis, or *Snake-Lizard*, which is a native of the southern part of Africa; it possesses four minute limbs, each provided with

Fig. 328.—Snake-Lizard.

four toes. In the *Anguine Lizard*, also a native of South Africa, the limbs are still more reduced, and have each but a single toe. The *Scheltopusic*, a native of Northern Africa and South-Western Asia, and common also in the Morea, has no fore-limbs, and the hind-legs are mere scaly appendages.—In the *Ophisaurus*, or *Glass-Snake*, of Carolina, there is an entire absence of limbs; yet there are certain anatomical peculiarities, which indicate that it belongs rather to the Saurian than to the Ophidian group.

502. In the family Scincidæ, or *Skinks*, we meet with a similar gradual transition from the form of the Lizards to that of the Serpents; but the animals composing it differ from those of the last family in the arrangement of the scales, and in certain other peculiarities. The head is covered with large plates of an angular figure, as in the true Lizards; but the body, tail, and limbs, are covered with uniform overlapping scales, having a glossy and polished aspect, and presenting almost the appearance of a coat of mail. These scales are composed of a mixture of bony and horny matter, and only occur in this and the following family. The true *Skinks* have four legs, and a sharp-edged muzzle, by which they bury themselves in the sand of the deserts they inhabit. One species, a native of Arabia, Northern Africa, &c., was long held in repute, on account of its supposed medicinal virtues.—From these we pass, through genera in which the limbs are reduced to mere footless appendages, and others in which either the anterior or posterior pair is deficient, to the genus *Anguis*; of which one species, inhabiting our own country, is known as the *Slow-worm*, or *Blind-worm*. In this animal, which is from twelve to fifteen inches in length, the legs are reduced to mere rudiments, which do not manifest themselves

externally, but may be traced by careful dissection beneath the skin. The Slow-worm frequents copses, orchards, old mouldering walls, and banks, where it delights to bask in the sun; it is a sluggish, timid creature; and its food consists chiefly of worms and slugs. Its whole body is as brittle as the tail of the Viviparous Lizard; breaking asunder on the slightest attempt to bend it, or on a trifling blow, in consequence (as it would seem) of the violent contraction of the muscles induced by alarm.

503. In the family of GYMNOPHTHALMIDÆ, the approach to the Serpents is particularly evident; for not only do we find the body very elongated and snake-like, and the limbs either rudimentary or entirely wanting, but the eyes are destitute of eye-lids, and simply covered, as in the Snakes, with a transparent portion of the skin. The scales are of the same nature as those of the Skinks. The majority of the species are found in Australia, but one inhabits Hungary and the East of Europe, and another is a native of America.—Two other small families, which still more curiously connect the Lizards with the Snakes, remain to be noticed. The first of these is the family of the AMPHISBÆNIDÆ, cylindrical, worm-like creatures, with the tail excessively short and rounded; so that as their eyes are very small, and sometimes hidden by the skin, the animals look almost as if they had a head at both ends. The skin is not scaly, but appears to be divided into a quantity of quadrangular plates by transverse and longitudinal furrows, which gives the animals the appearance of being ringed, like Worms. Although the limbs are generally quite deficient, one Mexican species, the *Chirotes*, has a pair of very small anterior members. Most of the Amphisbænas live in the tropical parts of America, but one species is found in the South of Europe and North of Africa. They bore into soft earth, like worms, working their way with considerable despatch; and feed upon worms and insects, especially Ants and White Ants.—The TYPHLOPIDÆ resemble the Amphisbænas in some respects, especially in the worm-like form of the body, and the division of its surface into quadrangular plates by transverse and longitudinal depressed lines. They differ from them and from all other Reptiles, however, in only

possessing teeth in one of the jaws. They are found in the warm parts of both Hemispheres, where they live, like the Amphisbænas, in the ground or under stones, often burying themselves to a depth of three or four feet during the rainy season. They feed principally upon insects and worms.

504. Besides the fossil Reptiles already referred to, some of which establish, in such a remarkable manner, the connexion between this class and the other Vertebrata, we have still to refer to one of the most singular groups of Reptiles yet discovered, either in the recent state, or amongst the ruins of the ancient world. The remains of the *Pterodactylus* (Fig. 307), the chief peculiarity in whose structure has been already noticed (§ 468), are found in the lias and oolite formations; mingled with the remains of large insects, such as Dragon-flies and Beetles. There can be no doubt that they were adapted to lead the life of the Bats and Swallows of the present day; restraining the multiplication of the Insect tribes, at a period when neither Birds nor Bats existed. Some of the larger species may not improbably have been partly aquatic in their habits, and may have fed on fish. From the size and form of the posterior extremities, the Pterodactylus seems to have been able to walk and perch upon them, after the manner of Birds; and with the anterior and posterior combined, it could probably walk and climb on rocks and cliffs, like Bats and Lizards. Several species have been already found, and more probably remain to be discovered; their size varied from that of a Snipe to that of a Cormorant. One of these was remarkable for the enormous length of its head; in all of them the neck was very long, and thus enabled the head to make a sudden dart upon the prey.

Order III.—OPHIDIA.

505. The division of the class of Reptiles which includes the *Serpent* tribes, is one which is almost universally regarded with feelings of horror and aversion. These doubtless originate

in the venomous qualities of certain families of the order, and in the terrific strength that characterises others; and also in the insidious manner in which they usually approach their victims. The prejudice is unjust, however, as regards a considerable number of the order, which are neither furnished with poison-fangs, nor of a strength or size to render them dangerous to Man; and when it can be overcome, there is much in the beauty of their markings, and the grace of their movements, to excite our interest. The species belonging to this order may be grouped under two principal sections, as *Colubrine* and *Viperine* Snakes. The *Colubrine Snakes* are those in which the maxillary bones extend along the whole sides of the mouth, and bear teeth throughout; so that the upper jaw exhibits four rows of teeth, two in the maxillary, and two in the palatine bones. In the *Viperine Snakes*, on the contrary, the maxillary bones are reduced to a very small size, placed quite at the front of the mouth, and endowed with great mobility; they each bear a single long, curved, and perforated fang (§ 473), which communicates with a large poison-gland (§ 474), and which by the movements of the maxillary bone is capable of being raised or depressed at pleasure. This section consequently includes none but venomous Snakes; but some of the Colubrine Snakes are also endowed with venomous powers, and these are distinguished by the presence of fangs amongst the other teeth in the upper jaw; the fangs in these poisonous Colubrine Snakes are, however, necessarily incapable of motion.

506. The perfectly harmless Colubrine Snakes, or those in which there are no grooved fangs in the upper jaw, form two principal families,—the COLUBRIDÆ, or *Colubers*, and the BOIDÆ, or *Boas*. Of the former of these, which contains more than half the entire number of species of Snakes, we have an example in our own country, the common *Ringed Snake;* which is abundant in low moist woods, damp meadows, and hedgerows in the vicinity of water; these being the situations in which its favourite food, the Frog, is always to be procured. In this fondness for water, and in its power of swimming with facility, the Ringed Snake differs from the Viper, which prefers dry localities. It is a voracious animal, and pursues its prey with great

determination; besides frogs, it feeds on mice, shrews, and nestling birds; these are swallowed whole, whilst yet alive, by the peculiar mechanism of the jaws (§ 473). This Snake may be readily tamed, and exhibits feelings of attachment to its protector. It passes the winter in a state of torpidity, retreating to some sheltered situation, in which numbers often collect, for the sake of preserving their warmth; in an instance which has come within the Author's knowledge, as many as 1300 were found in an old limekiln. The length of this species is usually between three and four feet; in tropical countries, however, the Colubers attain a much greater size. — The family Colubridæ includes many species which habitually reside among trees; and these are, for the most part, distinguished by the brilliancy of their colours, and the gracefulness of their forms and movements. They are harmless and very tameable. The *Tropidonoti* of North America, which are also of a very gentle disposition, especially frequent water, in which they are described as swimming rapidly in pursuit of Frogs and Fishes.

507. Whilst the Colubridæ are very widely distributed,

FIG. 329.—BOA CONSTRICTOR.

some species being found in almost every part of the world, the

Boidæ are restricted to tropical climates. They are Serpents of very large size and enormous muscular strength; and from their power of coiling round and firmly compressing the bodies of their victims, they are able to overcome animals of the largest dimensions. The tail has great prehensile power; and is much aided in its grasp by two hook-like claws sheathed with horn, which are supported upon bones that obviously represent those of the hinder limbs, in their position and attachments; these claws are put in action by powerful muscles, and serve as a kind of antagonist to the tail in grasping any object. The true *Boas* are restricted to America; the name of *Python* being given to the large Serpents of Africa and India. There is no doubt that individuals of both genera occasionally attain a size that enables them to overpower and gorge animals of large size, such as Men or Cattle; but these are rarely met with,—the usual length of these Serpents being from 15 to 30 feet. It is related by Pliny, that the army of Regulus was alarmed by a huge Serpent, whose length was 123 feet; but it is doubtful how far this account is to be relied on. A well-authenticated instance has occurred in recent times, however, of the destruction of a Snake above 62 feet long, whilst in the act of coiling itself round the body of a man. After having destroyed the life of their victims by the compression of the body, these huge Snakes proceed to envelope them whole in their capacious swallow; and owing to the remarkable power of distention, which the jaws and œsophagus possess, even the bodies of men and cattle can be thus ingulfed. After gorging themselves to a degree which causes the skin of the neck to appear as if it would burst, they retire to their hiding-places, and there continue in an almost torpid state, until the process of digestion has been completed; after this period (which sometimes lasts a month) is over, the Snake again issues forth in search of its prey. The Boas of America seem to have been tamed by the ancient Mexicans; and to have been especially used by the priests, as instruments for impressing the people with awe and reverence for their power. In the genus *Eryx*, belonging to this family, the tail is short and not prehensile; and this is also the case in the Tortricidæ, a small family of

Serpents which inhabit the tropical regions of both Hemispheres. Unlike the true Boas and Pythons, which find a home amongst the branches of the trees, these Snakes, which are of comparatively small size, dwell upon the ground, where they feed upon insects and other small animals. They are described as being slow in their movements.

508. We come now to the Colubrine Snakes with fangs amongst the ordinary teeth in the maxillary bones, of which a good many are known to be venomous; whilst the remainder, although some of them are reputed venomous in the countries where they occur, are probably of a harmless nature. In these *suspected* Snakes, the fangs are placed at the back of the jaw, behind the common teeth. Of these we need only refer to the HOMALOPSIDÆ, of which numerous species reside in India and the islands of the Eastern Archipelago, where they live in the ponds and rivers, and sometimes attain a considerable size.

509. These fresh-water Snakes lead us naturally to the *marine* HYDROPHIDÆ, which are characterized by the compressed form of their short tails, which enables them to move through the water with facility. In their general aspect and movements they strongly resemble Eels; they appear very rarely to quit the Ocean, and indeed they are said to be incapable of living for any time out of salt water. They are exceedingly venomous, and are objects of great dread to the fishermen, in whose nets they often occur. These Serpents, of which more than fifty species are known, are peculiar to the Eastern Seas; in most parts of which they occur, from the coasts of India to those of Australia and New Zealand.

510. The only other family of venomous Snakes belonging to this section is that of the ELAPIDÆ, or *Hooded Snakes*, in which the tail is round and tapering, and the poison-fangs, as in the Hydrophidæ, placed towards the front of the mouth, with the ordinary teeth behind them. They are also distinguished by having the skin of the neck very loose, and the ribs of that part so arranged that they can stretch the loose skin into a sort of disc, which from its resemblance to a hood has obtained these Snakes their English name. This is always done by the animal

when excited or irritated, at which times he raises the fore part of his body to a considerable height, so as to be ready to strike his enemy with his formidable fangs. The jugglers of the countries where these snakes are found, however, contrive to draw their fangs, and then teach them to assume their attitude of excitement, and move their heads from side to side to the sound of some musical instrument. Only two species of this family are known, one found in Egypt, and the other in India; the latter has a singular mark upon the back of its neck, resembling a pair of spectacles; from this character it is frequently called the *Spectacle Snake*.

FIG. 330.—EGYPTIAN NAJA.

511. The *Viperine Snakes*, of which the characters have been given already, form two families, the VIPERIDÆ and the CROTALIDÆ. The latter, including the Rattle-Snakes and a good many allied species, are distinguished by the presence of a deep pit, lined with small plates, on each side of the nose, beneath and generally a little behind the nostril. This pit is entirely wanting in the true Vipers.

512. The family VIPERIDÆ is a numerous one, and pretty widely distributed, although its members are restricted to the Eastern Hemisphere. One species, and this among the smallest, is an inhabitant of our own country; giving preference to dry woods, sandy heaths, sunny banks, and similar places. The *Viper*, or *Adder* (as it is commonly termed), is subject to great differences in colour; thus we have black, red, and blue-bellied varieties, which have been described (though erroneously) as distinct species. The Viper feeds upon small animals, such as mice, rats, birds, &c., which are very speedily killed by its bite; it never attacks Man, unless provoked to do so; and although

very unpleasant consequences follow the insertion of the poison-fangs into his body, it is very seldom (if ever) that *fatal* results occur to persons previously healthy. The Viper is ovo-viviparous, the eggs being hatched within the body; and the female, when loaded with them, may often be seen basking in the sun, and thus taking advantage of its warmth for the development of her offspring. The Viperidæ of tropical regions are much more venomous; their bite being commonly fatal to man. Amongst them we may mention the *Cerastes*, or *Horned Viper*, so called from a small pointed horn which arises from above each eye, which is celebrated from its being regarded as the Asp by whose bite Cleopatra died. When moving on the ground, its body always forms a series of parallel bends, and from this arrangement it is always prepared to spring forward and inflict its wound; in fact, under these circumstances its activity is said to be great, as it will spring to a distance of three feet, or about double its own usual length. The *Puff Adders* of Africa also belong to this family, and some of them attain to a considerable size; the common at least reaches a length of more than five feet.

FIG. 331.—RATTLESNAKE.

513. Of the family CROTALIDÆ, the true *Rattle-Snakes*, distinguished by the peculiar appendage to their tails, from which their name is derived, are confined to America; but there are other species belonging to this family, some of which are found in the Eastern Hemisphere, in Asia and its islands. The *Rattle* consists of a number of thin horny cells, which are articulated loosely to each other, and which produce a rustling noise when shaken. The number of joints increases, up to a certain amount at least, with each casting of the skin. The Rattle-Snake vibrates this

appendage when irritated or alarmed, and gives timely warning of its approach; it would seem, however, that most of the small animals on which it preys are so bewildered by the neighbourhood of their dreaded enemy, as to make but little attempt to escape. There is no reason to believe that it ever attacks Man, unless it be trodden on, or otherwise molested. Its bite, however, when severe, is almost certainly fatal; unless immediate measures be taken to prevent the absorption of the poison (§ 475); small animals, such as Dogs, are very rapidly affected by the poison, death taking place in a few minutes. The usual length of the common Rattlesnake is from four to five feet, but specimens have been met with of six or even eight feet in length.

514. The true Rattlesnakes are principally found in North America, but the southern division of that continent and the Islands of the West Indies are inhabited by numerous species of this family, in which the peculiar rattle is wanting, and the tail terminates in a little spine. One of the most terrible of these Serpents is known as the *Fer-de-Lance*, or *Lance-headed Viper*, which is common in some of the West Indian Islands; it measures as much as six or seven feet in length, and is capable of executing considerable springs when in pursuit of prey, or of some object which has irritated it.

CHAPTER VI.

CLASS OF BATRACHIA.

515. ALTHOUGH the number of species included in this class is small, the peculiarities which they present are of such a nature that they seem fully entitled to rank as a group distinct from the Reptiles, with which, however, they are still arranged by some Zoologists. They seem, in point of fact, to occupy a completely intermediate position between the Reptiles and Fishes, —as their respiration is aerial in the mature state, and aquatic when young; and even when adult, most of them still exhibit traces of the branchial arches from which the gills were suspended, springing, as in Fishes, from the hyoid bone. In some cases, the gills are even retained after the development of lungs has enabled the creatures to breathe air; and the question whether one of these should be placed with the Batrachia or the Fishes, is still a matter of dispute amongst Naturalists.

516. Small as the number of its members is, however, this class presents even a greater variety of form and organisation than that of Reptiles; the higher forms possess perfectly developed limbs, and many of them are quite lizard-like in their forms; whilst amongst the lower groups the limbs frequently become more or less rudimentary, and sometimes disappear altogether. The structure of the skeleton is still more variable; for whilst in some species we find the bones of the skull, vertebral column, and limbs perfectly ossified, in others even the vertebral column is reduced to what is called a *dorsal chord*, consisting of a thread of gelatinous matter enclosed in a fibrous sheath. In these the skull also is merely cartilaginous, and perfectly continuous with the dorsal chord. In the forms with a perfectly

ossified skeleton there are considerable differences in the structure of the vertebral column; some species having the bodies of the vertebræ concave on both surfaces, as in Fishes; whilst in the highest forms the vertebræ are united by a sort of ball-and-socket joint. The skull, which is broad and flattened, is distinguished from that of Reptiles by its possessing two condyles for articulating with the anterior extremity of the vertebral column; the orbits are of very large size, and the jaws are usually furnished with small teeth. Another peculiarity of the skeleton is, that the ribs are entirely wanting; but the vertebræ generally give rise to long transverse processes, which seem to a certain extent to take the place of ribs.

517. The skin is almost always smooth and naked; but it frequently contains a number of glandular organs, from which a peculiar acrid and disagreeable fluid is secreted. It lies loosely about the body, and is covered with a thin epidermis. In a few species it is covered with scales, and these in some cases appear to be analogous to those of Fishes.

518. In the structure of the nervous system the Batrachia approach the Reptiles, and the cerebral hemispheres usually constitute the greater part of the brain. The organs of the senses are generally more imperfectly developed than in the preceding class. The eyes, however, in the highest species are well-formed, and furnished, as in Reptiles, with eyelids and a nictitating membrane; but in some of the others they become quite rudimentary, and are even concealed beneath the skin. The ears, also, are usually concealed; but in the Frogs they have an external opening, furnished with a tympanic membrane; and the labyrinth consists of three semicircular canals, and a sac filled with little calcareous crystals. The tongue is usually large and fleshy; but in the Frogs and Toads it exhibits a singular peculiarity; it is fixed to the front of the jaw, whilst its tip, which is free, is turned backwards in the mouth. It can, however, be darted out with the rapidity of lightning, and it is in this way that these creatures obtain their food, which consists, like that of the Chameleon (§ 492), in which a somewhat similar organisation prevails, of living Insects.

519. The respiration of these animals is effected, as already stated, by means of lungs in the mature state; but as the ribs are wanting, it is evident that the air cannot be drawn in and expelled by a series of inspirations and expirations, in the same way as in the higher Vertebrata. We find accordingly that, as in the Tortoises, in which the ribs, although present, have no power of motion, the air is passed into the lungs by a movement of deglutition. The respiration is exceedingly sluggish, especially in cold weather; in warm weather it is far more active. A Frog, for example, which has been deprived of air, perishes in summer in less than two hours, whilst in winter it may continue to live for several days. A considerable amount of cutaneous respiration also appears to go on in these creatures, and during the winter this seems to be sufficient for the maintenance of their existence; in winter the lungs of a Frog may be removed without producing asphyxia, whilst in summer they have need not only of the pulmonary respiration, but also of the cutaneous, and death soon occurs when the air does not act upon the skin, or is excluded from the lungs. Limitation of the supply of air often produces in these animals a lethargic dulness, analogous to that of hybernating animals.

520. Like the Reptiles, the Batrachia are all oviparous, and in most cases the eggs are not impregnated by the male until after they have quitted the body of the female. The eggs are usually deposited in the water, even by those species which pass the greater part of their lives on land; they are enveloped in a glutinous matter, which unites them into large masses or long chains; the latter looking like necklaces of black beads. The masses of eggs of the common Frog may be constantly seen in the spring floating upon the water frequented by these animals. These eggs are remarkable as being those in which the entrance of the spermatozoa into the yolk was first seen by the late Mr. Newport.

521. But it is in the mode of development that we find the most striking difference between the Batrachia and the true Reptiles. Both are produced from eggs; but in the Batrachia the young are not evolved in the form which they ultimately

preserve, and in their early state they undergo some remarkable metamorphoses. They at first resemble fishes in their external form, as well as in their internal structure; and it is by degrees that they acquire the characters of their class. Whilst they are

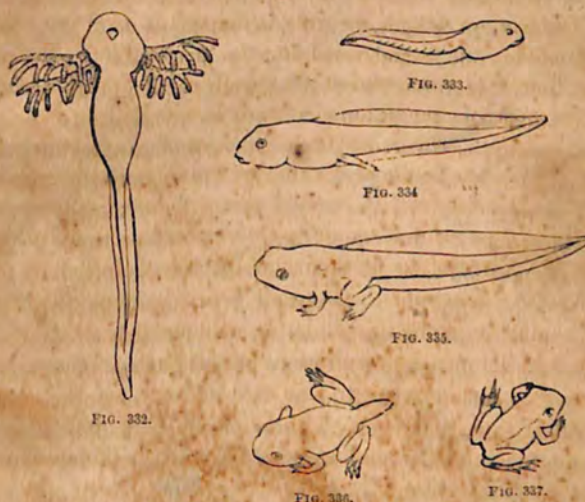


FIG. 332.

FIG. 333.

FIG. 334

FIG. 335.

FIG. 336.

FIG. 337.

FIGS. 332–337.—METAMORPHOSES OF BATRACHIA.

in this transitory state, the name of *tadpoles* is given to them, and the metamorphoses which they undergo are greater or less according to the species. Frogs, Toads, and other species formed almost on the same plan, are, of all the Batrachians, those whose metamorphoses are the most complete. At the time when the young tadpole of the Frog comes from the egg, it is very like a little fish, and can only live in water. Its head is very large, its abdomen protuberant, and its body, deprived of members, is terminated by a long and compressed tail; its mouth is as yet but a small aperture, hardly perceptible; and its gills only consist of a tubercle placed at each side of the posterior part of the head. These appendages are soon elongated and divided into laminæ; the eyes are distinguishable through the skin, and a transverse slit is seen under the neck, so as to form there a kind

of membranous operculum, analogous to the gill-covers of Fishes. By degrees, the gills (Fig. 332) ramify; and the lips are covered with a kind of horny beak; by the aid of which the animal fixes itself to the vegetables, on which it is chiefly nourished. This state, however, only endures for a short time. At the end of some days, the gill-fringes, which float on each side of the neck, disappear (Fig. 333); and respiration is performed by the aid of small vascular tufts, fixed along four cartilaginous arches, situated under the throat, and fastened to the hyoid bone. A membranous tunic, covered by the skin, envelopes these internal gills; to which the water comes through the mouth, by passing through the intervals of the arches of the hyoid; after having bathed these organs, the liquid escapes by one or two external slits, whose position varies a little according to the species. The respiratory apparatus then presents, as we see (ANIM. PHYSIOL. § 317), a most exact resemblance to that of Fishes. A little time afterwards, the posterior feet of the tadpole present themselves, and are developed little by little (Fig. 334); and they attain considerable length, before the anterior feet can be seen. —These last are developed beneath the skin, which they pierce more slowly (Fig. 335). About the same time, the horny beak falls off, and leaves the jaws bare; the tail begins to be atrophied (Fig. 336); the lungs are developed; and in proportion as these organs become more exclusively the seat of respiration, the gills shrivel up and disappear,—the cartilaginous arches which supported them being also in part absorbed; finally the tail entirely disappears, the little animal takes the form which it must ultimately preserve (Fig. 337), and completely changes its regimen. Herbivorous at first, it becomes by degrees exclusively carnivorous; and whilst these metamorphoses are taking place, its intestinal canal, at first long and twisted in a spiral form, becomes short, almost straight, and enlarged in parts corresponding with the stomach and colon.

522. The apparatus of circulation undergoes changes corresponding to those which the organs of respiration experience. The heart of the adult Batrachian is composed, like that of the Reptiles, of two auricles and a single ventricle; whence arises

a large artery, which swells at its base into a contractile bulb, and which is sometimes bifurcated to form the two arches of the

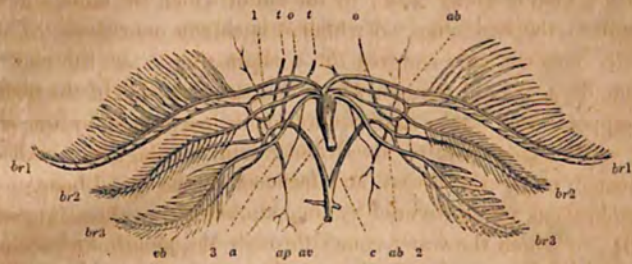


FIG. 338.—BLOOD-VESSELS OF THE TADPOLE IN ITS FIRST STATE.

a, artery originating from the single ventricle, and dividing into six branchial arteries, *ab*; *br.* 1, *br.* 2, *br.* 3, the three pairs of gills, from which return the branchial veins *vb*. The second and third branchial veins on each side form a trunk, *c*, which unites with the opposite one to form the great dorsal artery, *av*; the first pair of branchial veins send off the trunks, *t*, *t*, to the head.—1, 2, 3, communicating branches, connecting the branchial arteries with the branchial veins, in this stage very small; *ap*, pulmonary arteries, as yet but little developed.

aorta. But when the young animal respires by the gills only, the blood forced out of the ventricle is distributed to these organs; and thence the greater part is returned into a dorsal artery,

FIG. 339.—The same, in a more advanced state; the communicating branches are now enlarged, so that much of the blood transmitted to the branchial arteries finds its way at once into the branchial veins, without passing through the gills; the pulmonary arteries, *ap*, are also much increased in size.

whose branches convey it to the rest of the body (Fig. 338). We have elsewhere seen (ANIM. PHYSIOL. § 289), that among

Fishes, the blood follows the same course; but when the lungs are developed, the arrangement of the vascular apparatus changes; there is established a direct communication between the arteries which carry the blood to the gills, and those which return it from these organs; so that the nutritious fluid is no longer compelled to traverse this apparatus of aquatic respiration, in order to arrive at the dorsal artery, and thence into the different parts of the body (Fig. 339). The artery (*a*) which arises from the ventricle, and which might be at first compared to a branchial artery, then becomes the origin of the dorsal trunk, and forms with it a true aorta; of which certain branches, that are sent to the lungs, are developed at the same time, and establish the pulmonary circulation. Finally, the branchial vessels are obliterated, and then the circulation becomes almost the same as in true Reptiles (Fig. 340). The venous blood, returning from every part of the body, is poured into the ventricle by one of the auricles, and is there mixed with the arterial blood coming from the lungs, and forced into the same ventricle by the other auricle. This mixture then passes into the aorta; a small part of it being distributed to the lungs, and a larger part to the different organs of the animal.

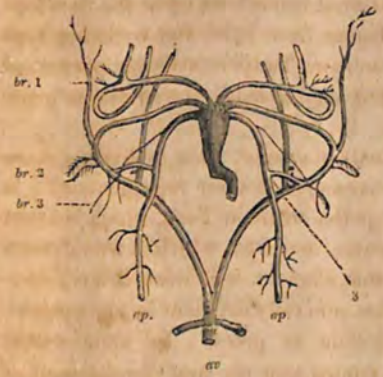


FIG. 340. The same, in the perfect animal; the gills have now disappeared, and the course of the blood is entirely through the communicating branches; that of the first pair conveys it direct to the trunks, *t*, *t*, supplying the head; and those of the second and third to the aorta, *av*. The respiratory circulation is now entirely carried on by the pulmonary arteries, *ap*.

523. Certain Batrachians undergo less complete metamorphoses. Thus Salamanders, like Frogs, acquire members in the progress of time and lose their gills; but they also preserve their long tail (Fig. 344): and, as we have already stated, there are also some of these creatures which, as regards their mode of respiration, always remain in the tadpole state; for their gills are

preserved during the whole of life, and the development of the lungs is stopped at an early stage.—It is one of the most curious proofs of the influence of external conditions upon the development of animals, that, by seclusion from light, and by being kept at a low temperature, the common Tadpole may be prevented from changing into a Frog, and may be made to continue to grow as a Tadpole.

524. A few of these animals, however, seem to diverge more or less from these general characters in their reproduction. It has been repeatedly stated that the common Toad, which is often found in localities far from water, and from which it would seem to be difficult for it to get at that element, will breed in such situations; but these assertions are generally deficient in some points, which render them inadmissible as proof. In some exotic species, however, it is well known that the first development of the egg takes place out of the water. An instance of this is furnished by the *Pipa* or *Surinam Toad* (Fig. 341). In this

Fig. 341.—Pipa.

ugly animal, which is found commonly in dark corners about houses in Guiana and Surinam, the back of the female, during the breeding season, exhibits a number of pits. The male, after impregnating the eggs, which are deposited in the usual manner at the margin of the water, collects them together and presses them into the pits on the back of the female, which then form regular cells for their reception, covered with a sort of lid. The development of the embryos takes place in these curious recep-

tacles, and the young animals emerge from them as perfect little Toads. A small Frog, a native of Venezuela, also exhibits a curious phenomenon of nearly the same kind. In this animal, the back of the female has a large double pouch under the skin, in which the eggs are stowed away; the development of the embryos certainly takes place in these receptacles as far as the development of the feet, but what becomes of them subsequently is as yet unknown.

525. After the preceding account of the general structure and habits of the Batrachia, it will be unnecessary to dwell at any great length upon the subordinate groups. The class may be divided into five very distinct orders. I. ANURA, or *Frogs* and *Toads*, in which the adult animal is destitute of a tail.—II. URODELA, or *Newts*, with four limbs and a tail, but with no branchiæ in the mature state.—III. AMPHIPNEUSTA, or *Sirens*, with a naked skin and two or four legs, and in which the branchiæ are retained when mature.—IV. APODA, which are quite destitute of limbs.—And V. LEPIDOTA, with a fish-like body, clothed with distinct scales, four simple limbs, and permanent branchiæ.

ORDER I.—ANURA.

526. The references already made to the species of this order the Frogs and Toads, which from their abundance must be familiar to every one, will render any detailed account of their form or structure unnecessary. In their habits they vary considerably, some of them living principally in the water, whilst others only visit that element at the breeding season. Their food consists principally of insects, which they swallow whole, and generally alive. The order may be divided into three families: I. RANIDÆ, or *Frogs*. II. BUFONIDÆ, or *Toads*. III. PIPIDÆ, or *Surinam Toads*.

527. The RANIDÆ, or *Frogs*, have the hind legs much longer than the anterior pair, so that they are enabled to perform considerable leaps; the upper jaw is always furnished with teeth, and the tongue is extensible. Of this family the *Common Frog*

is a well-known example. It is generally to be found in the neighbourhood of water, and swims well; but after it has finally quitted the Tadpole condition, by the casting of the last portions of its tail, it passes the greater part of its life on the ground, preying upon insects, which it captures with its extensible tongue. Numerous species of Frogs occur in warm climates, but their habits are generally similar to those of the common Frog. The *Tree Frogs*, however, of which one species is abundant on the continent of Europe, are adapted for an arboreal existence; the extremities of the toes being dilated into little pads, usually endued with a sticky secretion, which are of great service to them in climbing about trees. They are active little creatures, and elegant in their forms; they are able to change their colour to suit the objects which surround them. They breed in the water, and, like the common Frogs, bury themselves in the mud to pass the winter.

FIG. 342.—HYLA OR TREE-FROG.

528. The BUFONIDÆ, or *Toads*, differ from the Frogs in the absence of teeth in the upper jaw. They are also of a heavier appearance, and the hind legs are much shorter than in the Frogs; so that they are incapable of performing the leaps which are characteristic of the movements of the Frogs. The skin is covered with glandular warts, from which an acrid fluid is secreted. They feed, like the Frogs, on insects, which they capture by means of their extensible tongue. Their eggs are laid in the water in long necklace-like strings, enclosed in a gelatinous matter.

FIG. 343.—TOAD.

529. The family of the PIPIDÆ, which is peculiar to America, is distinguished from both the Frogs and Toads by the absence of the tongue; and from the Toads by the large size of the hind feet, which are webbed to the extremity of the toes. The *Pipa*, or *Surinam Toad*, already referred to (§ 524), is an example of this group.

ORDER II.—URODELA.

530. In the order URODELA, we seem to have the representatives of the Saurian Reptiles amongst the Batrachia; and indeed, by Linnæus and the older naturalists, these animals were arranged amongst the Lizards. From these, however, they may always be easily distinguished by their naked skin. From the Frogs and Toads they differ in the persistence of the tail, but, like them, they have four limbs, which are usually well developed.

FIG. 341.—NEWT.

531. The principal family in this order is that of the SALAMANDRIDÆ, or *Salamanders*, of which the common *Newts* of this country are familiar examples. These little animals have a flattened tail, and are to be found, in spring, in almost every piece of water, where they come to deposit their eggs. During the remainder of the year they live upon the dry ground; and in winter they collect together in considerable numbers in a hole in the ground, or under clods of earth, and thus hybernate in society. The *Salamanders*, distinguished by their rounded tails, are more terrestrial in their habits than even the Newts; they do not even visit the water to breed, but their eggs are hatched and the young developed in an enlarged portion of the oviduct; so that they are to be regarded as ovo-viviparous.—The remainder of the order is formed by the family AMPHIUMIDÆ, in which there is a small branchial aperture on each side, and within this

the branchial arches with small laminæ. They evidently form a transition to the next order, in which the *external gills* are persistent. The species, some of which reach a length of three feet, are for the most part inhabitants of North America. Their limbs are very small, and they live principally in the mud.

Order III.—AMPHIPNEUSTA.

532. The species of this order in some respects resemble the Urodela; they have a naked skin and a permanent tail. They are distinguished, however, by the existence of persistent external branchiæ, projecting from behind the head. They form only two families,—the Proteidæ and the Sirenidæ. In the former the tail is compressed, as in the Newts; the four limbs are developed, and the branchiæ are of large size. The *Axolotl* (Fig. 19) is an example of this family. It is a native of the Lake of Mexico, where it attains a length of from ten to fifteen inches, and is considered as an article of luxury by the inhabitants of the city of Mexico. The *Proteus*, a curious blind animal, found in the subterranean waters of the Carinthian caves, also belongs here. The Sirenidæ, or *Sirens*, have only the two anterior legs developed, and these are small; the body is nearly cylindrical, and the branchiæ small. They are peculiar to the Southern States of North America, where they live principally in the marshy rice grounds. The *Siren lacertina*, the best known species, sometimes measures three feet in length. It feeds upon worms and insects.

Order IV.—APODA.

533. The apodal Batrachia, or those in which the feet are entirely wanting, and the body cylindrical and worm-like, form only a single family, that of the Cæciliadæ, so called from the

minute size of their eyes. In their form they present no little resemblance to the Amphisbænas, which they also resemble in their habits, burrowing like earth-worms in soft ground, in pursuit of worms and the larvæ of insects, which constitute their food. They are usually from one to two feet in length, but sometimes attain three times that size.

Order V.—LEPIDOTA.

534. This last order of the Batrachia also includes only a single family, and this is composed of but three or four species. The best known of these are the *Lepidosirens* (Fig. 20), which inhabit the fresh waters of South America and Africa; a fine specimen from the latter continent is now to be seen living at the Crystal Palace at Sydenham. During the dry season these animals bury themselves in the mud, and fall into a torpid state; they form a regular chamber, which they line with a sort of cocoon, consisting of solidified mucus.

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